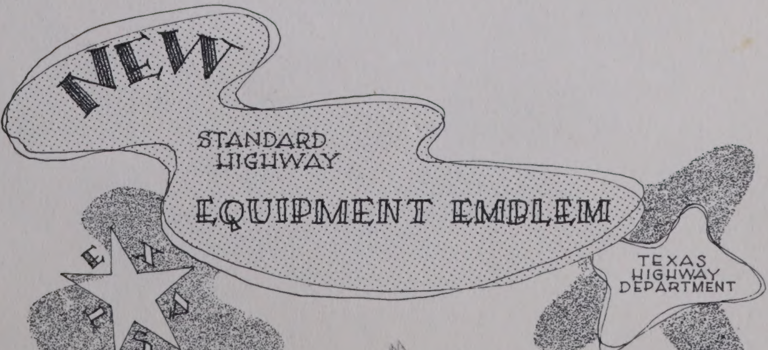
TEXAS HIGHWAY DEPARTMENT

Construction & Maintenance

BULLETIN No. 12

1952



Foreword

This bulletin is published for the purpose of presenting practical information applicable to current highway problems. These conclusions and data are not necessarily endorsed by the Highway Department nor are they to be construed as instructions. Employees are invited and urged to submit suggestions and relate experiences which would benefit those engaged in the construction and maintenance of highways.

Photographic services are available and other assistance may be obtained if desired in preparing material for submission. All material and comments should be directed to the Chief Engineer, Construction & Maintenance, Austin, Texas.

Published Jointly by

Maintenance Division	**D- 3**
Equipment & Procurement Division	**D- 4**
Construction Division	**D- 6**
Traffic Services Division	**D-16**

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TRAFFIC SERVICES DIVISION
REPRODUCED
OPERATIONS DIVISION
TEXAS HIGHWAY DEPARTMENT
AUSTIN 14, TEXAS

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As We See It . . .

It is interesting to note the results of a survey made by a private company recently in which each new employee was requested to list the most important considerations in connection with his new job. The following is a summary of the survey:

1. Safe working conditions
2. A good boss
3. Hours of work
4. Steady employment
5. Training
6. A chance for promotion
7. A chance to use own ideas
8. Amount of pay
9. Pension and insurance
10. Fair hearing in complaints

The above could very well be a list of the advantages of working in the Department.

It is no wonder that more than 2,500 employees have chosen to work ten or more years for the Texas Highway Department.

Setting Up Roadside Parks

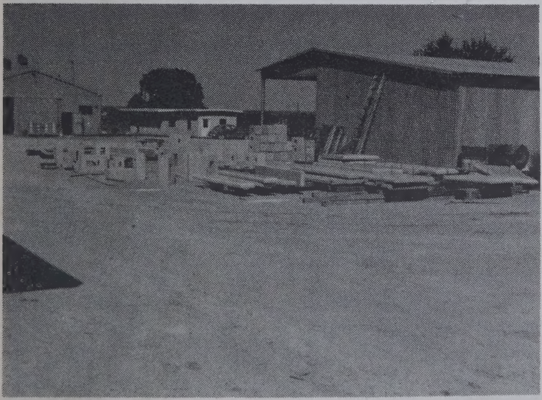
W. D. DOCKERY, ***District Engineer***

The pictures below show the steps involved in assembling precast concrete tables and benches developed in District 14 for use in roadside parks.

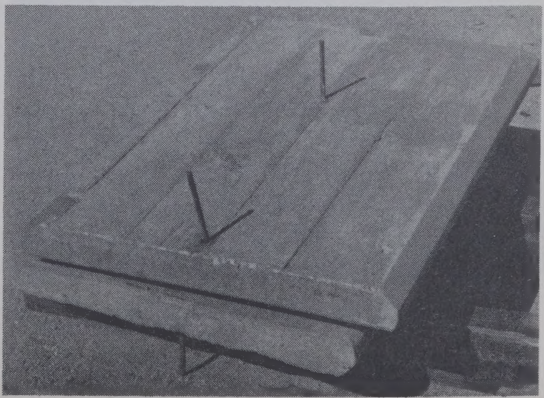
In developing this particular table and bench we have attempted to find some means whereby unskilled labor can set up a roadside park without the necessity of sending construction crews to the various locations several times in building a roadside park. A mobile concrete crew can visit the park, pour the foundation slabs, and move on to the next site, thereby eliminating costly delays. The regular maintenance crew can then pick up a set of tables and benches, haul them to the park site, and assemble them in approximately 30 minutes. The cost of precast concrete tables and benches in the stockpile is approximately $75. This cost can probably be reduced if a sufficient number of tables are made.

For all of the smaller parts, such as table legs and bench legs, hinged steel forms are used, which are readily collapsible, and should last for a long time.

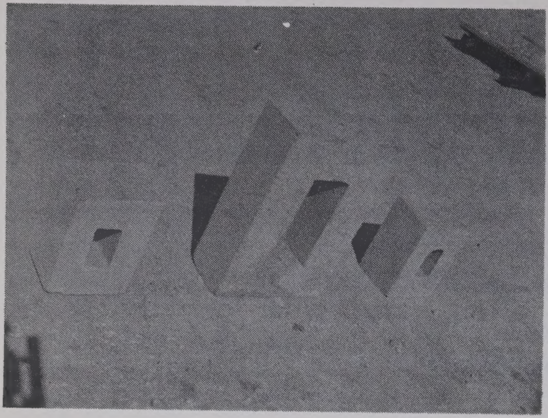
The tracing shows the entire table, benches, and foundation which we are currently using in this District.



Stockpile of precast tables and benches at Travis County Maintenance Warehouse.

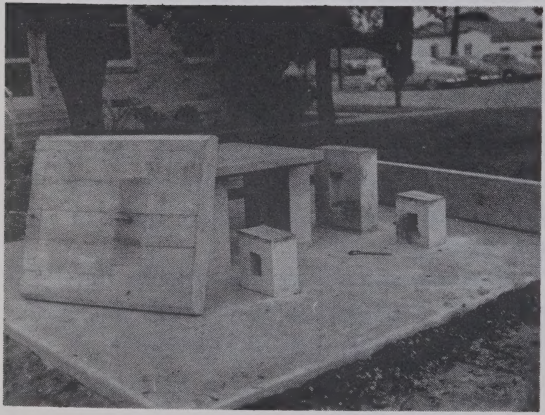


Close-up of precast table top.

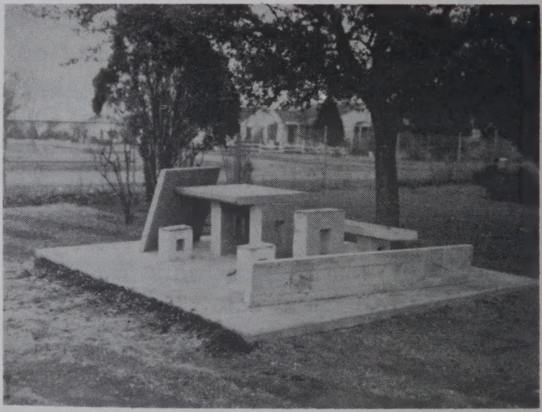


Close-up of precast table and bench legs.

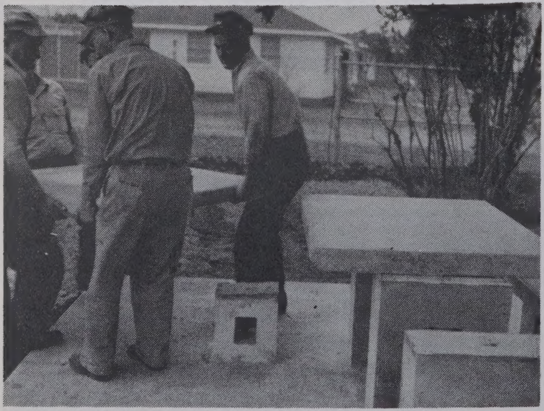
Assembling precast table and benches on previously placed slab.



Close-up showing partially assembled table and benches.

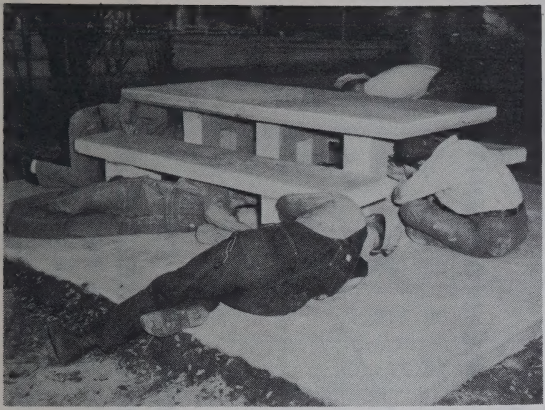


Another close-up of partially assembled table and benches.

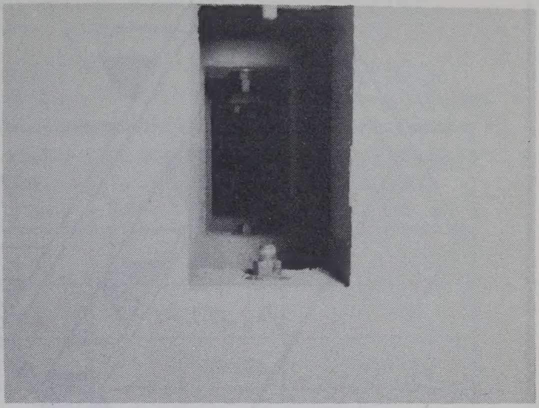


Assembling table and benches.

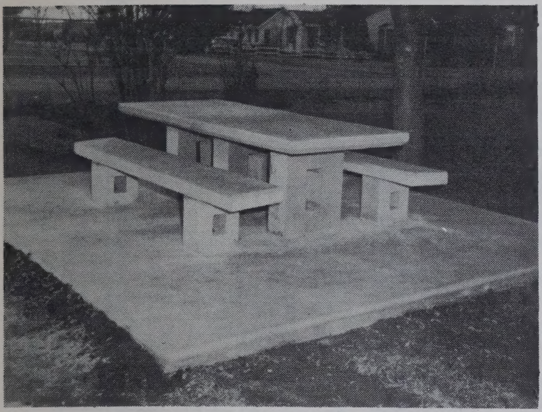
Assembling table and benches.



Final bolting up of table and benches.



Close-up showing table legs bolted to slab.



Precast concrete table and benches in place.

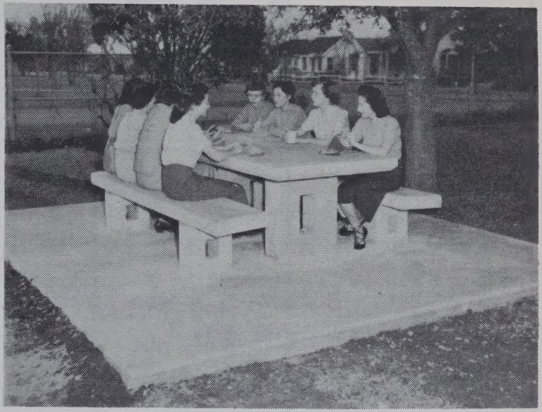
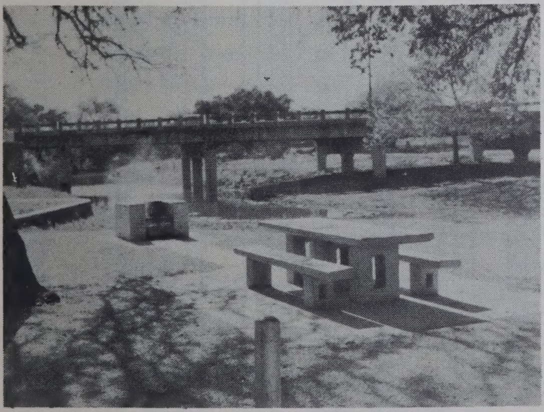
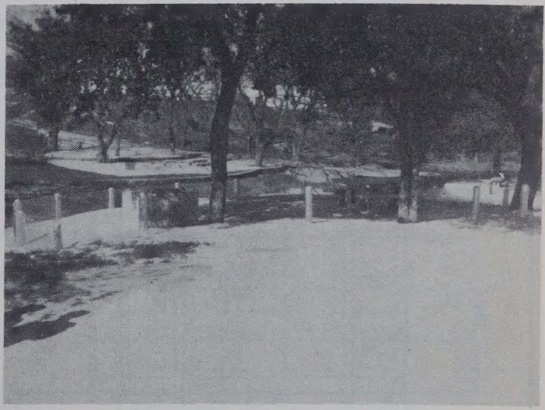


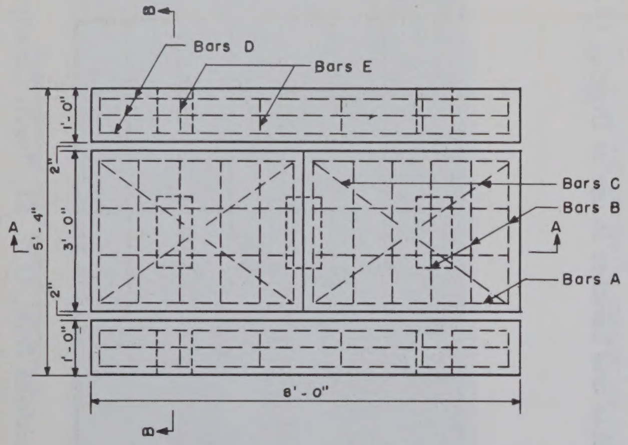
Table and benches in use at District 14.



Table, benches, and firebox in place in Roadside Park, Travis County.



Roadside Park, U.S. 81, Travis County.



PLAN

ESTIMATED QUANTITIES

REINFORCING STEEL

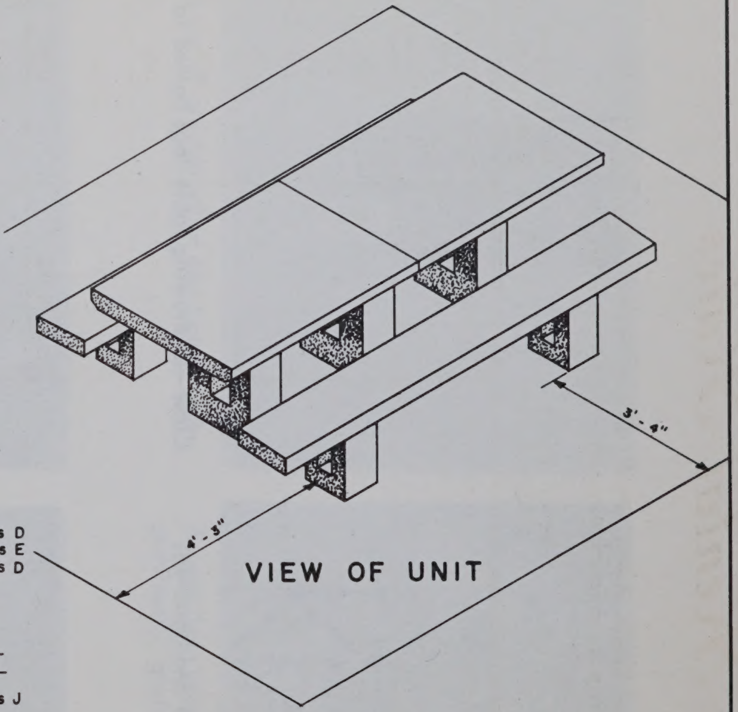
BAR	NO.	SIZE	LENGTH	SPAC.	WT.
A	8	1/2"ϕ	3'-8"	11"	20 lbs.
B	12	"	2'-8"	9	18 "
C	8	"	2'-0"	—	11 "
D	6	"	7'-8"	4"	31 "
E	12	"	8"	1'-6"	5 "
F	12	"	1'-10"	—	15 "
G	6	"	2'-8"	—	12 "
H	16	"	10"	—	12 "
J	8	"	1'-8"	—	9 "
K	10	"	11'-8"	1'-3"	78 "
L	12	"	13'-8"	1'-3"	110 "

CONCRETE

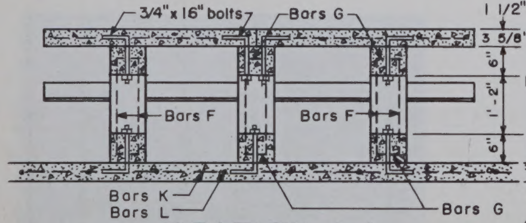
Table & Benches	.76 Cu. Yd.
Foundation Slab	2.05 Cu. Yd.

BOLTS

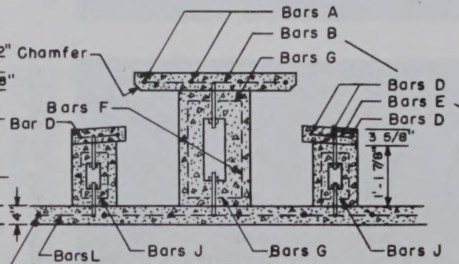
3/4" x 12"	8 Each
3/4" x 16"	7 Each



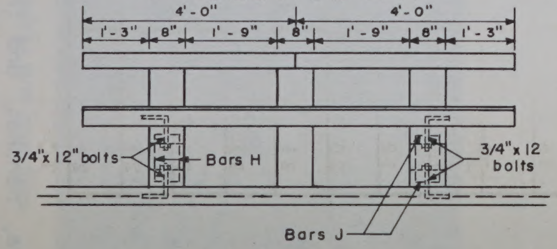
VIEW OF UNIT



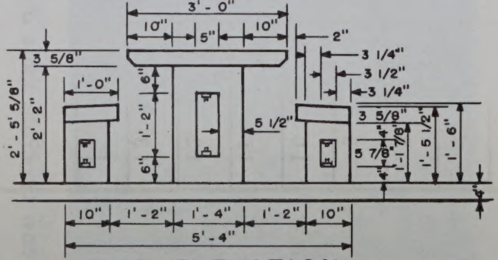
SECTION A-A



SECTION B-B



SIDE ELEVATION



END ELEVATION

ROADSIDE PARK FIXTURES

PREFABRICATED TABLE & BENCHES

TABLE & BENCH TYPE T-5

SCALE: 1/2" = 1'-0"

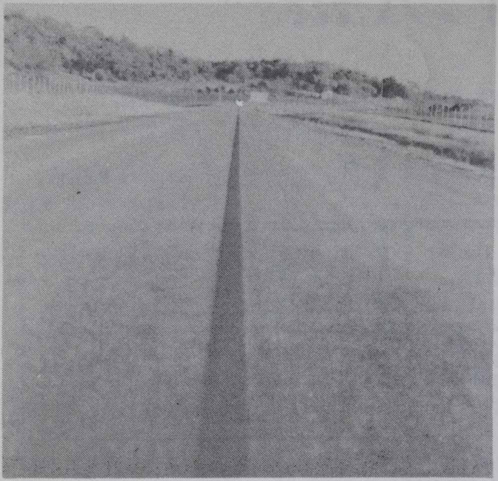
COUNTY	PROJ.	SHEET NO.

Rental Rates

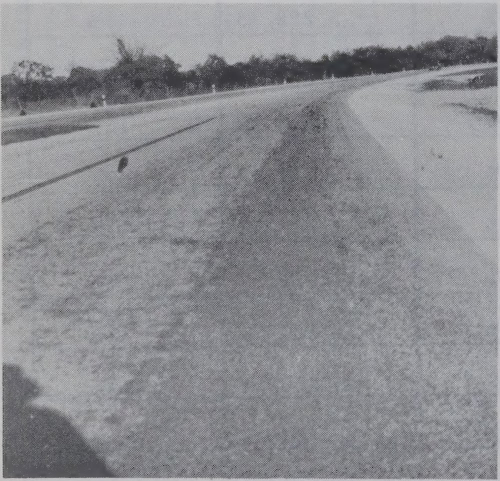
"Comparison of Rental Rates, Profit & Loss Statement by Districts for the period from May 1951, to March 1952."

	Rental Rates as of May 1, 1951		Rental Rates as of March 26, 1952	
DISTRICT NUMBER	Profit or Loss as of May 31, 1951	Over or Under Code 24A Base Rates	Profit or Loss as of Feb. 29, 1952	Over or Under Code 24A Base Rates
1	$- 6,041.68	-15%	$ 5,406.45	-15%
2	9,076.90	Base	15,251.94	- 5%
3	29,111.61	-30%	3,523.52	-20%
4	11,536.56	Base	35,504.50	-10%
5	- 4,516.99	-20%	-22,433.53	- 5%
6	15,562.41	Base	551.13	Base
7	- 840.18	- 5%	-12,995.31	5%
8	13,464.23	Base	29,626.48	-10%
9	17,096.51	-30%	-18,408.88	-15%
10	24,479.62	-30%	-16,831.08	-15%
11	10,538.39	Base	28,766.38	-10%
12	45,807.26	-20%	- 3,180.42	- 5%
13	5,852.46	-20%	- 2,268.30	-15%
14	-14,276.68	- 5%	8,850.13	- 5%
15	12,297.72	-15%	- 3,672.19	-10%
16	-13,599.08	5%	- 3,810.61	10%
17	5,576.73	10%	25,057.53	Base
18	797.08	-25%	-14,904.17	-15%
19	13,457.54	-25%	2,164.66	-25%
20	- 7,789.14	15%	82,886.19	-10%
21	15,138.66	10%	28,124.04	Base
22	6,965.32	Base	14,139.82	- 5%
23	17,992.22	5%	14,870.04	Base
24	16,491.98	5%	12,813.10	Base
25	866.77	Base	- 5,164.49	Base
TOTAL	$225,046.22	Av. -.076%	$203,866.93	Av. -.072%

Profit and Loss reduced approximately 10 per cent.



Highway 71, Bastrop County
Original base for this 5.4 mile project was crushed iron ore which developed failures after a few years use. A study revealed too much soil binder and too high P.I. A mixture of gravel and coarse sand from the Colorado River was windrowed along one edge and this material plus existing iron ore plus 3 per cent commercial lime was mixed for a depth of six inches by blading. The surface was sealed using MC-5 Cutback Asphalt in the bottom and OA-230 in the top of a double asphalt surface treatment. Shrinkage cracks have developed, but no failures to date.



U.S. 79, Williamson County
One of the oldest experimental sections, constructed in August, 1945. Existing limestone gravel base had failed. Three per cent waste lime was mixed with existing base for a depth of six inches. The base was sealed with a triple asphalt surface treatment. No failures have occurred to date. The surfacing was widened in 1951.

Lime Stabilizatio

H. C. CARTE

In Texas one can travel over expressway highways costing well over a million dollars a mile, and one can travel farm to market roads costing only a very few thousand dollars a mile.

There is a vast difference in the location and design standards of these two extremes and yet there are a number of things in common for all types of new improvement. One is the ever-increasing problem of finding suitable materials with which to build the bases and subbases within the limits of available funds and commensurate with the amount of weight of traffic.

There are approximately 1,600 miles of asphalt surfaced roads in District 14. A few years ago most of the mileage consisted of light asphalt surfaces applied directly on selected materials. This low cost design was adopted, many years ago, as the initial step in stage construction, not only because it was necessary to keep expenditures within available funds, but because it was believed to be the best method of obtaining stable pavement on poor subgrades. The lack of replacement during World War II and the increase of traffic and loads in recent years have made corrective measures a necessity. Some roads have broken up and become too rough for comfortable and safe use. Depressions of excessive depth and bulges of excessive height have developed. This movement of the subgrade probably denotes overloading, caused by limited distribution of wheel loads through existing thin bases. The only solution for this problem was to build thicker and better bases.

In District 14

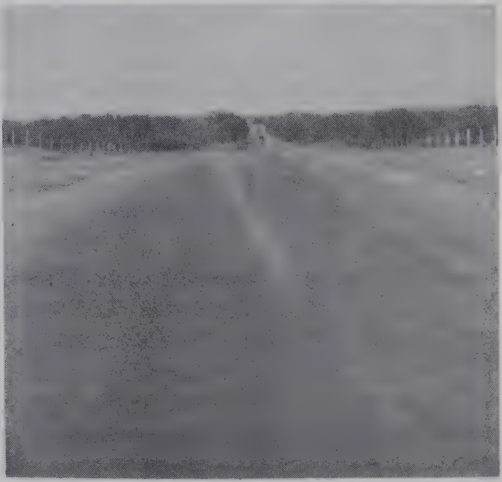
District Construction Engineer

Thus, it may be seen that in addition to the base material problems encountered on new construction, there is an equal problem of providing suitable base material for betterment work and heavy maintenance.

District 14 contains quite a variation of local materials. When viewing the granite gravel in the western part of the District, the caliche and rock on the Edwards Plateau, the old gravel pits in the rolling black farm lands or the Post Oak Belt on the eastern edge, it would appear that there is an abundance of good flexible base material. However, few deposits of local material have been found which will meet present flexible base specifications without the use of additive or by crushing and frequently both are required.

From this brief summary it may be seen that it was necessary for District 14, like most of the other Texas Highway Districts, to devote more time and study to the base material problem, and to enter into the field of stabilization. The most used is "mechanical stabilization." Here, two or more materials are combined by mixing to produce a much better final product. Asphalt, cement, sodium chloride, and calcium chloride stabilization have been used and lastly, yet by no means the infant of the group, Lime Stabilization has been used. Combination of Mechanical Stabilization and the various materials have been used. However, the subject of this paper is Lime Stabilization. This is by no means a new idea. The U.S. Bureau of Public Roads, in cooperation with several states, undertook the in-

U.S. 81, Williamson County
This section was a source of trouble for years due to high P.I. base material and seeps along rock ledges. In 1947, 82 per cent gravel, 15 per cent caliche, and 3 per cent waste lime were mixed by blading on an unused street in Round Rock and six inches of this mixture were placed full crown width and sealed with a light double asphalt surface treatment. No failures have occurred to date. The surface was sealed again in 1950, using Emulsified Asphalt-High Viscosity-Rapid Setting and Type B, Grade 5 Aggregate.



F.M. 685, Williamson County
The original base for this 3.0 mile project was white rock which developed failures after a few years use. In 1946, four inches of inferior base material (high P.I. limestone gravel) was added and stabilized with three per cent waste lime and sealed with a light double asphalt surface treatment. Shrinkage cracks have developed but to date, no base failures have occurred.

vestigation of the effect of lime and earth roads in 1924. Since that time a number of states have experimented with lime as a stabilizer for both earth and base materials. In 1939 the Texas State Highway Laboratory set up a research project to study the effect of lime when mixed with clay soils.

Lime Stabilization falls generally in two periods in this District. First, that period during the war when short experimental sections were constructed using maintenance forces. The first of these projects was developed after every effort to locate a material to reduce the plasticity of the existing selected material on sections of U.S. 79 and U.S. 81 in Williamson County had been exhausted. A scarcity of suitable flexible base material in Williamson County, made necessary an attempt to find an admix that would be satisfactory and at the same time economical. During this study it was noticed that large stockpiles of waste lime were available at the lime plants at Round Rock and McNeil. Laboratory tests indicated that waste lime or commercial lime produced satisfactory results.

For 60 samples taken from the existing flexible base on U.S. 79 between the M.K.T. Underpass and 1.0 mile west of Hutto, a distance of five miles, the average plasticity index was 17 and the average per cent of soil binder was 43. There were two sections of this road that were failing badly. The average plasticity index for these sections was 18 and the per cent of soil binder was 35. A special job was set up providing for admixing 3 per cent (by weight) of waste lime from McNeil with the top six inches of the existing flexible base. The total length of the two sections was 0.6 mile. The work was performed in August, 1945. Samples taken from the road mixed material and the completed road indicate that the resultant plasticity index was 8 and the per cent of soil binder was 27. The cost of treating 2,215 cubic yards (compacted) was $1,350.86 or $0.71 per cubic yard, which would be $0.101 per square yard or $0.017 per square yard per inch of depth. Had commercial lime been used, it would have cost $1.26 per cubic yard or $0.21 per square yard or $0.035 per square yard per inch of depth. The above prices include the lime, scarifying, mixing, rolling, sprinkling, and curing. Other test sections were constructed in several counties and except for minor spot patching, all of the lime-stabilized sections have been highly satisfactory. As mentioned above, waste lime was used. This included everything from the kiln that was not sacked. The waste was dumped in piles and in old quarries, and over a period of years developed a crust several inches thick of calcium carbonate which preserved the lime. During the construction hard lumps of limestone were encountered in the waste lime material, but the larger of these was removed by hand and the smaller pieces were incorporated into the base.

The second period extends from the end of the war up to the present. Approximately 87 miles have been treated with lime. The depth of treatment has ranged from four inches to eight inches. The work has been performed by both state forces and by contract. Both waste lime and commercial hydrated lime have been used. Width of stabilization has varied from 20 feet on farm to market roads to 60 feet on city streets. The following has been common to all the projects: 3 per cent by weight of lime (based on the dry weight of base material) has been used and all the materials treated have been so-called "inferior" base materials, that is, materials containing aggregate and usually with a plastic binder. The projects have been in areas where local fine or blow sand was not available. On most of the projects the materials have been mixed directly on the roadway and all mixing has been by blading. On some of the work within cities the materials have been premixed and hauled to the street. For the projects mixed directly on the roadway, the construction methods have been about the same. The gravel was normally dumped in the center of the road. The piles were evened by blading, leaving a trench, or "V," in the center. This was to hold the lime to avoid waste since it will flow ahead of the blades. The windrow was then bladed back to the center to "wrap up" the lime. The material could be left in this position for short periods, even in wet weather, without apparent damage. The windrow was cut in half and each half bladed out to the crown line. The left windrow was then completely bladed across the road to the right again forming one windrow. The total was then bladed completely across the road to form one windrow on the left. One half was then carried back to the right and the material "laid in" by taking a cut from first one windrow and carrying it uniformly across the roadway and then a similar cut from the other windrow. The thoroughness of the mix can be detected by eye because of the whiteness of the lime. Finally, the remaining windrows were bladed to about the 1/4 points and the edges "laid in" in light lifts. Each lift was sprinkled and rolled as it was placed in its position. The mixing for the city street work was performed by dumping the material in windrows on some available open area near the project. The lime was added and the material was mixed by blading in the same manner as described above. After thoroughly mixing the material it was hauled to the jobs and bladed and sprinkled in light lifts. Sprinkling was controlled to insure a total moisture content of about Proctor optium or just a little drier. The completed base was then maintained in a damp condition by sprinkling for three to four days. The base should be finished completely smooth and so maintained for two reasons. First, the hardened base is quite hard to cut. It requires large amounts of water and numerous grader blades. Second, the retempered top layer is not as durable as the original mixture. In spite of these two points, quite a number of the bases constructed in this District have been refinished immediately ahead of the asphalt. This work was necessary because the projects were carrying traffic and the traffic caused enough abrasion for the surface to be rough.

The projects constructed in this District have been subjected to rains in almost every stage of the construction at one time or another with no apparent damage. A rain during the mixing period will normally require more blading to dry the material in order to complete the mixing.

Below are typical test results of some of the material before and after treatment:

			Per Cent Retained On							
No.	Local Name	Lab. No.	2"	1"	1/2"	1/4"	40	LL	PI	LS
1.	Flint Gravel	46-300	0	13	26	39	73	39	24	12
	Same + 3% Waste Lime	46-304		11	25	37	72	34	6	3
2.	Iron Ore Gravel	46-2016	0	4	29	40	75	41	25	10.1
	Same + 3% Waste Lime	46-2018	0	2	24	35	73	35	9	4.0
3.	Limestone Gravel	47-150-E	0	12	32	50	69	29	17	9.0
	Same + 3% Lime	47-150-E+					73	30	8	3.6
4.	Granite Gravel	47-1846		0	15	40	88	43	22	8.3
	*Same + Lime + Sand	47-1847		0	11	33	75	32	5	3.2

* 15% Fine Sand - 3% Lime added at the same time.

The weight of materials in this District containing aggregate compacted in the roadway will range from 3,300 to 3,500 pounds per cubic yard. If the average were 3, 333 pounds and 3 per cent lime were used this would amount to 100 pounds, or two sacks, or 1/20 ton of lime per cubic yard compacted. The cost of lime, which includes furnishing, emptying, and disposing of the sacks on contract work has ranged from $16 to $21 per ton. An average of five jobs is $18. 80 per ton. The cost on state force account jobs has ranged from $17.15 to $21. 33. An average of four jobs is $18.74. The cost of emptying and disposing of the sacks has been about $1. 50 per ton on state force account jobs. It should be mentioned that since completion of the nine jobs mentioned above, in 1949, the cost of lime and freight may have increased. Assuming the cost of lime at $20 per ton in place on the windrow, this would amount to $1 per cubic yard of compacted stabilized base.

It requires approximately one hour of blading time for each 50 cubic yards of "inferior" base material to mix the lime and "inferior" base material. As mentioned above the lime stabilized base should be damp cured. The cost of "inferior" base material, plus haul, blading, sprinkling, and rolling could be determined for any given locality. To this amount should be added approximately $1.26 per cubic yard or $0. 21 per square yard, six inches thick, to obtain the cost of Lime Stabilization.

In conclusion there are several points that should be mentioned:

(1) Not all materials react with lime. Some show no reaction, some show varying degrees of hardening, while other materials become very hard and durable. It is believed that the cementing agent is calcium silicate and the silica must be furnished in fine form. For example, binders containing small amounts of bentonite will harden while beach sand will show little strength.

(2) Lime Stabilization, like all stabilization, requires complete preliminary laboratory study and close control during construction. The simplest test, of course, is to mix some of the material with lime, dampen, compact, and see if the material will harden. For the effect of lime upon the plasticity, the District 14 Laboratory combines the material and lime and adds enough water to bring the soil binder to approximately its plastic limit consistency. The material is then compacted by hand into one mass in a pan and allowed to set undisturbed for seven days at room temperature. The material is then broken up, slaked, and washed, and the soil tests are run in the usual manner on the prepared binder. The strength of soil lime specimen, in terms of internal friction and cohesion can be determined as described by Mr. Chester McDowell and published in the 1946 Proceedings of the Highway Research Board. It should be remembered that lime mixtures harden comparatively slowly and the strength will increase for some time after mixing.

(3) Part of the cost of Lime Stabilization is involved in hydration of the quick lime, separation, sacking, and then opening, emptying, and disposing of the sacks. The thought has been expressed that lime could be added in solution. To check this a number of laboratory jars were prepared, each containing the same amount of lime. The water was varied from 100 per cent to 700 per cent based on dry weight of the lime. All samples were thoroughly mixed and then allowed to stand undisturbed. It was observed that the samples with 100 per cent added water and 150 per cent added water did not show any marked amount of settlement at one hour. The samples with more water begin to show settlement at five minutes. The more water, the faster the rate of settlement, and at one hour all samples had settled at such a rate as to leave the lime at approximately the same height in the glass graduates. This limited test

would indicate that quick lime could be hydrated with up to 150 per cent moisture, the lime would stay in solution and the mixture could be pumped or would flow through gravity spray bars. This method of adding lime has not been tried in the field.

(4) Some of the older projects which were treated four inches deep are showing distress. It is believed that present day loads are causing excessive deflections in the subgrade and thus the hard thin bases are being destroyed. To date the six inch or thicker bases are very satisfactory. Time only will tell whether lime can be used to guarantee a uniformly low P. I. when mixed with a variable P. I. material and whether the results will be permanent. Also time only will tell whether any permanent strength has been added to the base. However, the oldest of the test sections is now about six and one-half years old and the stabilized material is still quite satisfactory.

(5) This last thought - Since the recent world war, the advent of the low cost farm to market type road has necessitated a considerable amount of study and investigation in order to obtain a base suitable for the traffic and purpose intended. For farm to market roads, this base has necessarily had to be low in cost in order to construct the large mileage now being demanded by the public. The amount of stabilizer required, and the increase in cost of all materials and construction, has made it necessary to compare the cost of what has been commonly called "low-cost stabilization" with the cost of hauling to obtain flexible base materials. In some instances in this District, the inferior type flexible base materials have been cheaper, and this cheaper material has been used, by proper changes in the specifications, when the amount and kind of traffic would permit. In other instances the type and amount of traffic has dictated a higher quality flexible base material and in the absence of natural "good quality" materials, stabilization has and is being used. The most economical stabilization to date appears to be the combination of materials or "mechanical stabilization." This is followed by a combination of mechanical stabilization and small amounts of hydrated lime.

Highway 29, Llano County (Right, no failures - left, failures.)
On this 17.7 mile project, various granite gravel pits were used. The depth varied from 6 to 10 inches. Lime was added to the top 4 inches on part of the project and to the top 6 inches on the rest. Soon after completion, an oil field haul started and numerous failures developed on the north side of the road. It is of interest that this project will be five years old this summer, and there have been no base failures where the depth of flexible base was 8 or more inches (even though the lime stabilization may have been only 4 inches) or where the lime stabilization was 6 inches in depth. The many base failures have been where a combination of thin base (6 inches) and thin stabilization (4 inches) were used.

U.S. 90 in Luling, Caldwell County
Typical municipal project constructed in 1948, 20-foot concrete pavement in center of street. Area between pavement and gutter was excavated for depth of 12 inches and back filled with limestone gravel, the top 6 inches of which was stabilized with 3 per cent commercial lime and surfaced with 150 pounds per square yard of Hot Mix-Cold Laid Asphaltic Concrete Pavement.

Highway 16 in Llano, Llano County
Typical municipal project constructed in 1949. The 12-inch base consists of a mixture of gravel and coarse sand from the Llano River, sand clay binder, and 3 per cent commercial lime. The street was surfaced with 150 pounds per square yard of Cold Mix Limestone Rock Asphalt Pavement.

Erosion Control

John C. Blasingame, *Senior Landscape Adviser*

The information in this article is based on, (1) the results of experimental plantings made in Districts 1 and 18 from 1948 through 1951, (2) conversations with various authorities on erosion control, and (3) observations of the conflict being waged continually between the forces of Man and Nature which seek to prevent or control erosion.

It is a generally accepted fact in the eastern and central portions of Texas that Bermuda grass is our best erosion control plant where conditions are favorable for its establishment and maintenance. However, this grass requires a fairly rich soil and will not tolerate shade or a dry and droughty situation. This means there are many locations along our highways where Bermuda grass is not practical or economical to attempt to establish. This grass cannot be economically established under most roadside conditions from seeding, and this method is no longer recommended for Bermuda grass. The usual methods of block sodding, mulch sodding, and sprigging are effective if properly used and are highly recommended but are fairly expensive.

Sprigging offers a good possibility of becoming an economical means of establishing Bermuda grass by use of a tractor-drawn, or tractor-mounted sprig planting machine that is now on the market. This machine, operated by two men on a prepared area, is capable of sprigging up to two acres an hour. This would be recommended, of course, only in areas considered suitable for the establishment and maintenance of Bermuda sod.

The need is great for an economical means of establishing a vegetative cover for erosion control in the areas where Bermuda is not practical, for reasons either of unfavorable conditions, or economy. Since seeding is economical and practical, if effective, it was decided to investigate the possibilities of establishing a vegetative cover for erosion control by seeding various varieties of plants in our roadsides.

It must be admitted at the outset that there is no foolproof formula that can be applied in solving erosion control problems. There are too many variables involved such as soil, weather, orientation, drainage, etc. Many cases have been observed where a good cover was produced on a slope on one side of a highway, but the same treatment, when applied directly across from it, was a complete failure. One slope, due to the orientation of the highway, may have been exposed to direct cold blasts of winter and frozen out, while the opposite slope was protected. Or the hot afternoon sun beating down at a fairly close to normal angle may have baked the soil on one slope, while the rays striking at a low angle on the slope which was opposite, did no harm.

It must also be admitted that no program of erosion control is likely to be final. You can't establish control and then forget it from that time forward. As a result of factors such as the weather, or a mechanical injury, as wheel ruts, setting up conditions which favor erosion, weak places develop. These must be reinforced or they may continue to get progressively worse at an accellerated rate, until a great amount of damage is done. The more quickly the damage is checked, the more economical the remedy will be. It is likely that more cover crops, which were at one time effectively established and then gave way to the forces of erosion, were lost because of being weakened by starvation than from any other cause. In some cases, a little fertilizer, which isn't very expensive, would have meant the difference between success and failure. Much damage has been observed, especially on the face of sandy slopes. This is a result of weak spots created at breaks in the vegetative cover made by wheels of mowing machines or some other type of vehicle. Failure from these, and most other causes, can be predicted far enough ahead of time to be prevented.

The "critical area" in the face of a cut slope is from the point near the top of the slope where the topsoil merges into the subsoil, to the point near the bottom of the slope where topsoil is encountered again as "made-soil." This is the area where the greatest difficulty is experienced in establishing a permanent cover. For this reason, the "critical area" has been given special attention.

The soil ordinarily encountered in the "critical area" contains very little available plant food and is tight and dense. It is well drained and in no condition to absorb and hold an appreciable amount of moisture. More often than not, it is bare and exposed to the vagaries of wind and rain. The hot sun of summer will heat it up to a temperature which burns out the life in the soil and prevents any volunteer plant growth from maturing. These conditions usually prove to be too rigorous for most plant life to survive. One method used with a great deal of success in overcoming these conditions is to spread a cover of vegetable matter, such as a straw mulch or cotton burs, over the face of the slope. This method, however, necessitates handling a large amount of bulky material and has proved quite expensive in most cases and prohibitive in others. The roadsides of our farm to market highways contain large acreages in which the above described soil conditions prevail. An economical means of establishing a protective vegetative cover is badly needed here and most of the experimental plantings were made on this type of highway.

The experimental plantings were based on the premise that when a sterile subsoil is turned over and pulverized, it becomes a much more favorable medium for plant growth. It was further assumed that by pulverizing the face of a slope and adding a proper fertilizer, a cover crop could, if planted at the proper season, be quickly grown in the "critical area" of a cut slope. The risk of losing the pulverized soil from the slope during a hard rain before a cover had been established was considered. It was decided that a fall planting, with the gentle rains at that season, compared to the springs torrents, had a better chance of avoiding this misfortune. Seeding at the proper season enables a plant to enjoy many advantages it does not have when attempting to grow during the wrong season. Ignoring this fact has been the cause of complete failure in some erosion control projects. Its importance cannot be too strongly emphasized.

The experimental seeding was done in various ways. A grain drill with fertilizer attachment, a Cyclone Seeder, hand distribution, and a tractor with two-row planter attachment were some of the methods used. Where conditions favor it, the grain drill is recommended over other methods. The Cyclone Seeder works well for sowing Rye grass over an existing growth of grass. The two-row planter spreads the rows too far apart for steep slopes with the result that soil washed out between the rows, leaving the plants on little ridges.

Fertilizer is considered very necessary to the success of seeding and was included in all of the experiments. Since legumes add a considerable amount of plant food to the soil, principally in the form of Nitrogen, several varieties including Biennial White Sweet Clover (Melilotus alba), Kobe, Korean and Serecia Lespedeza were tried out. A biennial or perennial plant will open up the soil to a greater depth since the roots have more than one year to develop. This is considered very important to the soil on the face of a cut-slope because it allows water to percolate to a greater depth and increases the absorptive power of the soil. The legumes chosen were upright growing varieties which admitted air and sunlight to the area of the ground around their stems. Bur clover has been observed to smother out Bermuda by its habit of growing so close to the ground. The legumes were planted with the thought that they would become "nurse-crops" to grasses which thrive on a rich diet of Nitrogen. This would eliminate the necessity of future fertilizing, a practice which would become a yearly necessity on some slopes without a "nurse-crop." This is commonly practiced by farmers in their pasture programs.

It is believed that the results obtained by seeding the various legumes were successful enough to warrant their recommendation as erosion control plants for roadsides. K. R. Bluestem grass is an excellent erosion control grass on dry slopes of poor soil, but is difficult to get established. More trial plantings should be made of this grass before it is recommended. Weeping Love grass gave more promise than any other that was used. This grass needs to be tried out to determine the areas it is best suited to. Italian Rye grass and wheat and oats are recommended highly for economical erosion control.

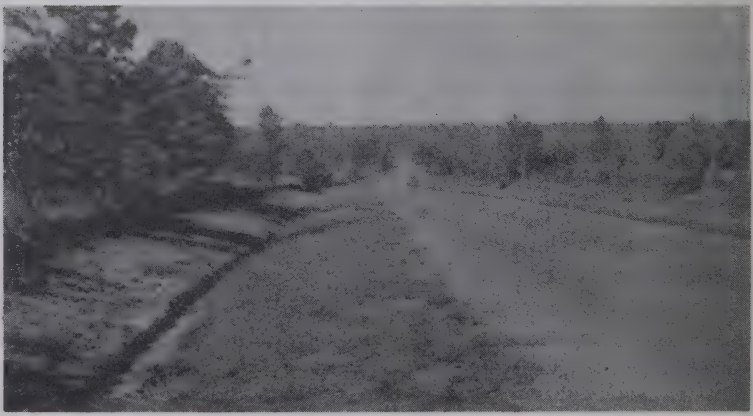
In erosion control, as in any other phase of maintenance, prevention is the best cure. Fortunately, barring some unusual or mechanically caused difficulty, the condition of the vegetative cover on the face of a slope can be predicted for a year or so in advance if studied closely. Advantage can be taken of this observation to plan for preventive maintenance at the proper season.

No data on costs, seeding rates, types of fertilizers, and rates of application of fertilizers are included in this report since the plantings could not be kept under close enough control and observation. It might be well to mention a few pertinent facts and observations. Proper time for mowing and the number of mowings per year have an important bearing on establishing some plants. This is especially true of annual plants which are reproduced from seed only, whereas, biennial and perennial plants may be reproduced from seed and from the roots. Most legumes must be inoculated with the proper bacteria. This can be purchased at seed stores in a neat, processed package. The seeding rate on slopes should be increased up to as much as double the recommended rate for seeding this same crop in pastures. A soil analysis made by a competent laboratory from a properly taken soil sample would be very beneficial in calculating fertilizers. The costs were held down below $50 per acre on all of these plantings, and in several instances where broadcast seeding was the only operation performed, the cost was held below $10 per acre. Good farm practices should be followed in planting roadsides.

Since most roadsides are in a good condition for seeding at some stage of construction, advantage may be taken of this low cost of establishing a vegetative cover by including alternate types of both cool and warm season crops as bid items in the Unit 1 contract. Alternate types of seeding, to be used at the discretion and direction of the Engineer, would enable him to choose the type seed deemed best suited to the particular location and to the season at which this planting would be done. There would not be a very long period of time elapsed before the battle against erosion would be started. This is as it should be. This seems a desirable step on all Unit 1 contracts regardless of the ultimate steps for erosion control that the contract might call for. When soil is effectively tied down in its proper place, the expense of cleaning it out of the ditches and culverts, needless to say, is eliminated. There is also the possibility that subsequent smoothing up of a large portion of the shoulders and backslopes, due to erosion while construction was going on, would be eliminated.

Our Texas Highway System yearly becomes more extensive and imposing. As a greater number of citizens use our highways, we become more concerned about their efficiency and appearance. Improved appearance will follow improved erosion control as a natural consequence. It is believed that improved erosion control will release many dollars and many man-hours for use in maintaining the riding surface, which is, of course, the prime reason for the existence of a highway right of way. The seeding of selected varieties of plants on our roadsides offers a good possibility of materially improving erosion control at a cost that is economically practical.

Note vegetation growing at top and bottom of slope. Bare area on face of slope is considered "critical area" from erosion control standpoint.



K.R. Bluestem growing on sandy shoulder.

Lespedeza growing on back slope two months after seeding was done.

The same back slope as above two years later. Lespedeza had been mowed a few days before this picture was taken.

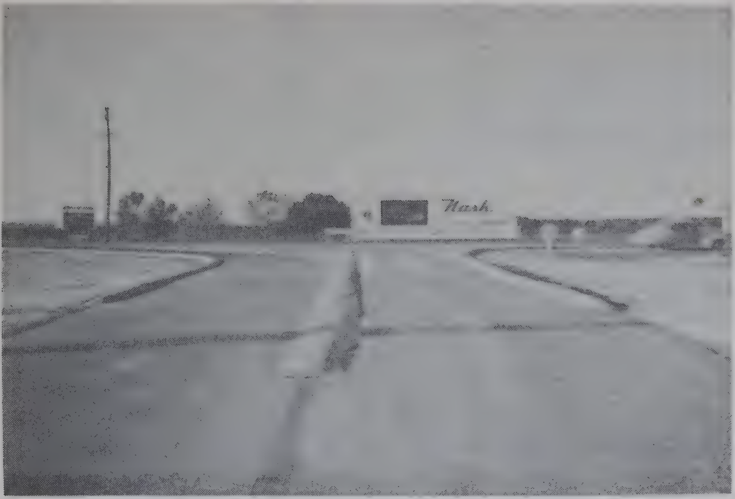
Weeping Love Grass two months after being seeded.

Weeping Love Grass at same location shown in picture above two years later.

Cut slopes at intersection of new primary highway and F.M. Highway. Estimated area on face of cut slopes is six acres. Slopes covered with Bermuda Grass mulch sod in October, 1950, and seeded with Italian Rye in November, 1950. Adverse winter weather in 1950 killed about 98 per cent of Bermuda sprigs. These pictures were taken in December, 1951. Note smooth face of slopes which indicates excellent erosion control. The only gulleys which are in evidence were started by unauthorized driving on slopes. Cost of seeding was approximately $7.50 per acre.

This man can sow a strip 16 feet wide with most varieties of seed while walking at a normal gait.

Fill slope which was covered with Bermuda Grass mulch sod in March, 1951. No seeding was applied here. Compare with above cut slopes.



Intersection of Loop 13 and Broadway, San Antonio.

Safe Turnings at Highway Intersections

H. W. McCABE, *Senior Maintenance Superintendent*

For many years we have been confronted with the common problem of part of the traffic using the shoulders and slopes to cut across at an intersection instead of staying on the pavement. Even though the pavement is adequate to accommodate the traffic, most of the vehicles do not drive on the paved portion.

The results have been a constant maintenance problem as well as the hazard of dust and loose gravel. We have made numerous experiments at intersections in the past such as widening the pavement, placing base preservatives on shoulders, guide markings, and pavement marking, none of which proved effective in keeping the traffic on the pavement during the turning movement.

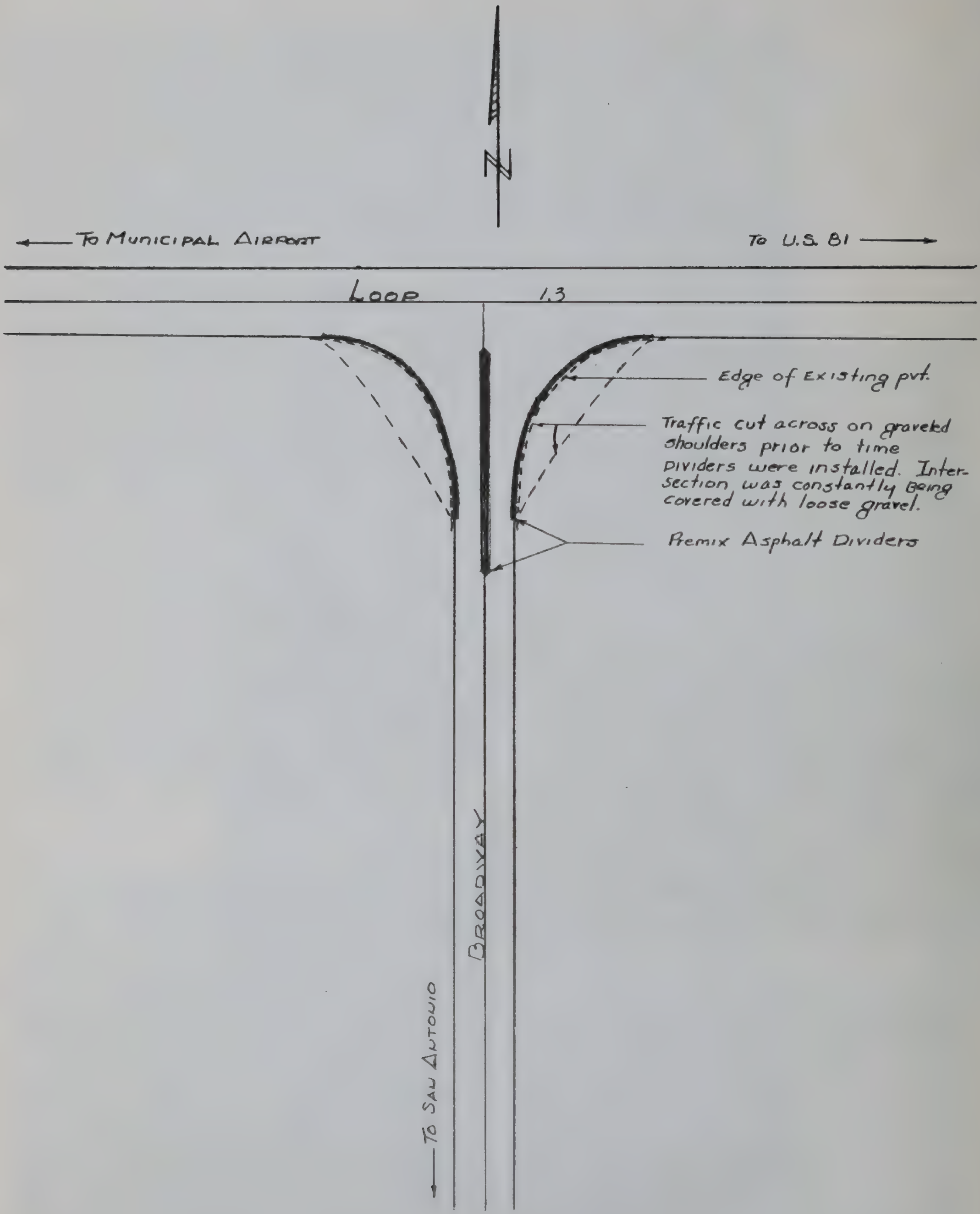
Recently we revised two important intersections near San Antonio on the north side; that of Loop 13 and Broadway, and U.S. 281 North at the Isom Road. We have been keeping close tab on both of these intersections and have found that they are serving the traveling public entering the highway at these intersections beyond our fondest expectation.

We have placed asphalt blisters in the center of the intersections approaching the highway, and at both edges of the same pavement we have placed a narrow roll asphalt curb. These blisters and asphalt curbs guide the traffic into the highways at the right angle which permits them to have a clear view of the approaching traffic in both directions. The blister, in the center, is approximately eighteen inches wide at the bottom with a thickness of about four inches. The dimensions of the asphalt curbs are about eight to ten inches at the bottom with a thickness of about four inches. The maintenance on these two intersections has been comparatively small insofar as the removal of loose gravel and broken edges is concerned.

May we again state that the results have been very satisfactory since the traffic entering the intersection has confined itself entirely to the lanes as marked. Also the Stop sign at these intersections is placed at such a position that the traffic can do very little about not coming to a complete stop or near-stop before entering the highway. We believe that this type of work can be done very economically at many of our intersections where this undesirable condition exists and the cost of the installation overcome, in a reasonable length of time, by the saving of maintenance cost.

"Before" pictures of Intersection of U.S. 281 North and Isom Road in Bexar County near San Antonio.

"After" pictures of the same intersection.



Edge of Existing pvt.

Traffic cut across on graveled shoulders prior to time dividers were installed. Intersection was constantly being covered with loose gravel.

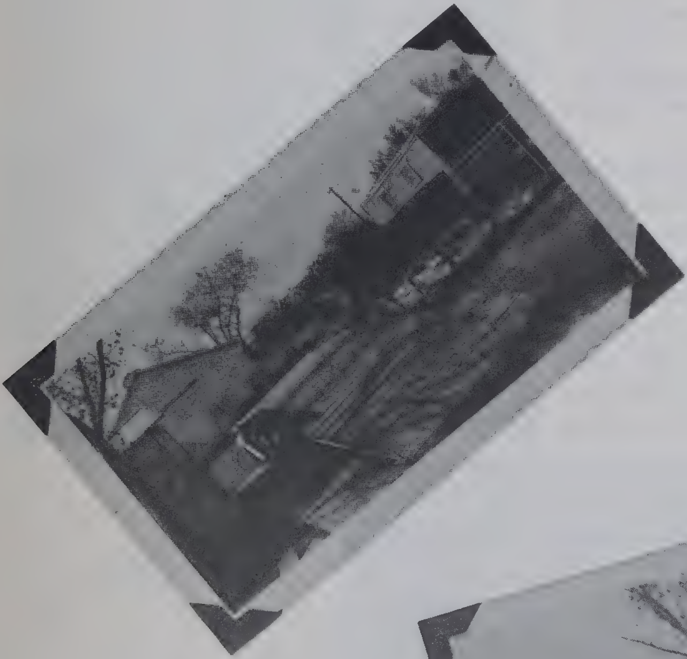
Premix Asphalt Dividers

LOADING RAMP AND BARREL RACK BUILT IN DISTRICT 6

Pictured are a loading ramp and barrel rack that have been constructed in District 6 at the comparatively low cost of $72. Salvaged railroad rails are cut and welded together to form the frame, and all sections are floored with salvaged timber decking. The ramp, loading platform, and barrel rack are made in three sections so that they may be easily dismantled and moved. The over-all dimensions of these sections are as follows:

Barrel rack	16' x 8' x 4'
Loading platform	10' x 8' x 4'
Ramp	20' x 8' x 4'

One of these complete units has been made in the District Shop for each Maintenance Foreman and they have proved very satisfactory. Since these units can be constructed so cheaply from salvaged materials, we thought they might be of interest to other Districts.



FIRST PROGRESS REPORT

Highway

Equipment an

This report is the first of several to be published in the Construction and Maintenance Bulletin in an effort to keep you posted on these tests.

Mowing is our most expensive operation in so far as repairs and down time are concerned.

Since the Department started doing its own mowing we have never been satisfied with the equipment available to us. At the start we were required to purchase farm type equipment which was not adaptable to our job. Only in the last several years has the industry attempted to build equipment with highway mowing in mind.

Our present specifications are designed around the heaviest sickle type mower offered today. While this mower is much more serviceable than the old farm type, it is still far short of what is desired in this type of equipment. It was for this reason we decided to purchase at least one of each new type mower on the market and conduct a test. What we are looking for is something that does not show up in a day of demonstration nor in a table of specifications; thus, these tests will be conducted over several mowing seasons.

Our first test was inaugurated in the fall of 1950 in District 15. Here we are testing a hydraulic type mower

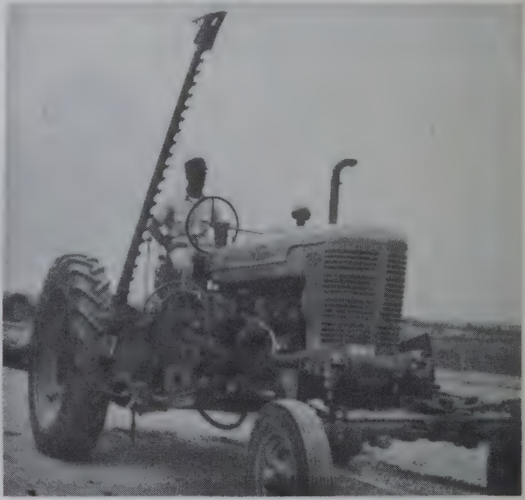


Exhibit "A"

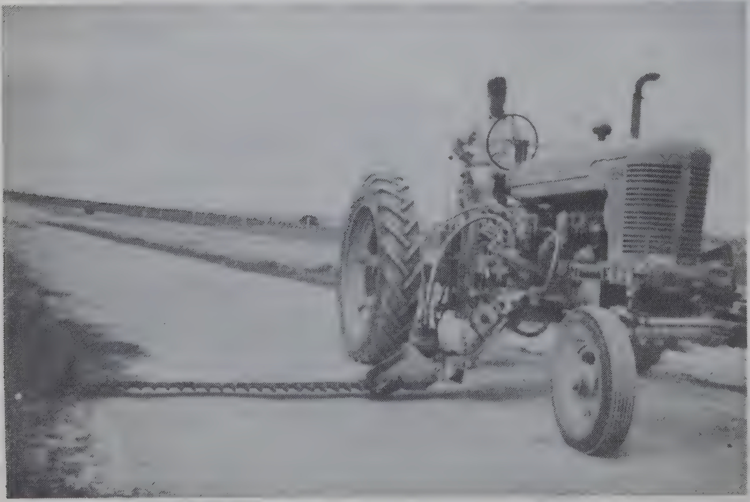


Exhibit "B"

Mower Test

Procurement Division

attachment on a standard wheel type tractor. The sickle bar is driven by hydraulic power rather than a direct power take-off from the engine. This gives a vibrationless, smooth drive with fewer wearing parts. All belts, chains, drive shafts, and universal joints are eliminated in this attachment. A pressure relief valve protects the knife and sections from damage by debris. The relief valve can be adjusted for heavy and light mowing. The constant speed power obtained from the hydraulic drive enables this mower to cut right up to an obstruction. The cutter bar is not affected by the speed of the tractor or the operation of the clutch. For mounting details and general appearance see Exhibits A, B, C, and D.

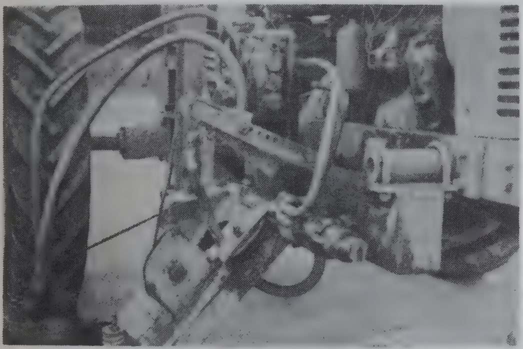


Exhibit "C"

We have just received the first detailed report on these attachments from San Antonio. This report was submitted by Mr. Charles T. Holmes, Assistant District Engineer. We quote Mr. Holmes's report below:

"Reference is made to our recent discussion of the hydraulic mowers in use in this District. We believe that some discussion of the performance of these units would be of interest.

The first unit, complete with Oliver "66" tractor was purchased in the fall of 1950, too late to permit any appreciable amount of use during that year. The following March it was assigned to Section Headquarters at Dilley for work in Frio, LaSalle, and McMullen

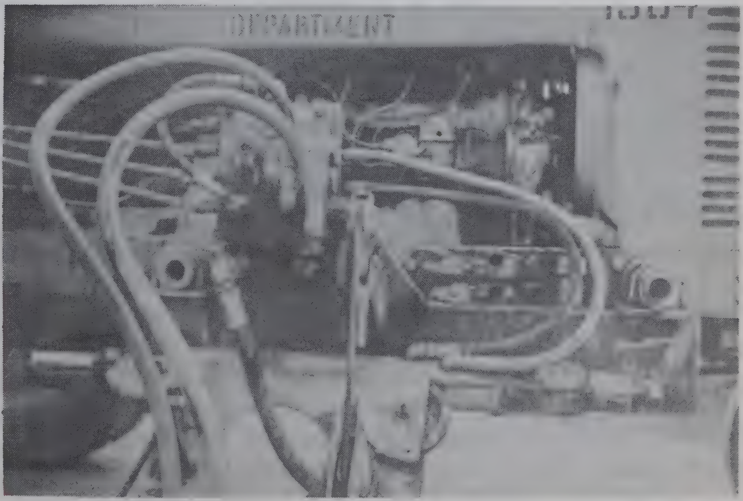


Exhibit "D"

Counties, where not only a heavy growth of weeds is usual, but on certain sections brush control is also difficult. During the entire 1951 season this equipment worked constantly with no trouble whatever and with only three hours shut down for other than minor adjustments.

In June or July four additional units were mounted on Model "M" International tractors and placed in service in Kendall, Bandera, Kerr, Johnson, Guadalupe, and Comal Counties. In those areas, we have the heaviest mowing in the District and in some sections the roughest right-of-way. These four machines operated during the remainder of the season with five calls for mechanics (one machine with no shop service). All foremen having this type of machine agree that, conservatively, the output of each machine is at least 50 per cent higher than for the conventional mower.

The unit is extremely flexible. It can be operated at varying speeds and at almost any angle of slope from vertical to 55 degrees below horizontal. The curb lift feature permits horizontal operation at a height of approximately 20 inches above the ground on which the tractor is running. This feature is particularly convenient in mowing steep sides and back slopes.

It has been found that the best service may be obtained with the pump driven directly from the front end of the crank shaft. This is easily accomplished by the use of an outboard bracket so that the pump can be driven off the fan drive pulley. The standard Model "M" fan drive pulley is replaced by a double pulley of the same size, which is standard for a 1-D-9 or T. D-9 International tractor.

One of the photographs enclosed shows the mounting of the mower unit by four "U" bolts to two brackets consisting of flanged 2 1/2 inch heavy hollow shaft. The entire assembly can be removed from the tractor in less than an hour with only simple tools and replaced equally simply. This feature permits the use of the tractors for other purposes during the off season.

The only changes made in the tractor are the substitution of the double pulley on the end of the crank shaft and the installation of a more comfortable driver's seat. It was found that the standard tractor seat was entirely unsuitable for operation on slopes and on rough rights-of-way. Not only was the standard seat fatiguing, but was hazardous in that the operator held himself on by clinching the steering wheel and operating levers.

We are enclosing a series of photographs of the mounting on Model "M" tractors. Similar mountings may be made on any other type of tractor having sufficient clearance between the front and rear wheels. However, attention should be directed to the necessity for placing the unit so that there is no obstruction to the movement of the ram which controls cutter position.

In this District, we are well convinced of the value of these units, even though the initial cost is considerably more than that of the conventional mechanical type."

As you have probably noticed, there are any number of the rotary type mowers on the market today. Demonstrations have indicated this type of mower has possibilities and it was deemed advisable to test several of these mowers under various conditions. The first of these tests was started late last fall in District 16. We purchased one each of three different makes. These mowers were not delivered until December but there is considerable winter mowing in this southern District and these mowers have been in use.

The F&F Cutter (See Exhibit E) is a rotary-blade type designed especially for three-point suspension type wheel tractors. The high speed rotary action cuts and shreds a sixty-inch swath of green or dry foliage. The cutter is adjustable from 2 inches to 16 inches above ground level.

The Caldwell Cutter is a rotary blade type designed to be pulled by any wheel type tractor. It is equipped with standard wheels using 6.00 - 16 tires. It differs from the F&F Cutter in that it has three 57-inch spinning blades that mesh with four stationary ones -- two on one side and two in front, the combination making six cuts with each revolution of the assembly. A shear pin protects blades from damage.

Exhibit "E"
F & F Cutter

The Servis Stalk Shredder is another rotary blade pull type unit. It also has multiple rotating and stationary 57-inch blades, meshed three inches apart. This unit is equipped with a shear pin type clutch to protect blades.

As stated above, this test has been under way only a short time and we have only a brief report from District 16 which we quote below:

"While we have not finished our tests on the rotary type mowing machines you recently purchased for us, we have used them enough to be of the opinion that the Ford Tractor equipped with the F&F Cutter is definitely superior to our old sickle type mower.

We have not used the pull type mowers long enough to form a definite opinion as to its adaptability for highway mowing. We are continuing the tests running all three machines on the same job and anticipate it will be two or three months before we will be in a position to decide whether the two pull type cutters will be satisfactory." (Exhibits E, F, and G show rotary mower units on the job).

In December we purchased for District 12 an extra large Lilliston Roto-Speed Cutter which is of the trail type and is completely belt driven. The manufacturer of this unit claims it can operate up to ten miles per hour and cut a clean 7 1/2 foot swath of green or dry vegetation.

This unit was not delivered until late December and we have not yet received a report on its operation. We should have something by our second progress report which, as stated above, will be published at a later date.

Exhibit "F"
All three rotary type mowers on one job.

Exhibit "G"
Trailer type rotary mower.

As mowing conditions vary throughout the state, we would appreciate any suggestions regarding this operation. It is our intention to conduct a very thorough study of our mowing operation and we will need much assistance from the field.

Widening and Resurfacing

Bulletin Number 11 contained an article by Mr. T. S. Huff on methods of widening and resurfacing old concrete pavements. These pictures show some of the work which has been done to extend the life of our primary highways. As Mr. Huff pointed out in his paper, observation of results on these earlier jobs should be a valuable guide in selecting methods for projects which are still needed on many major highways.

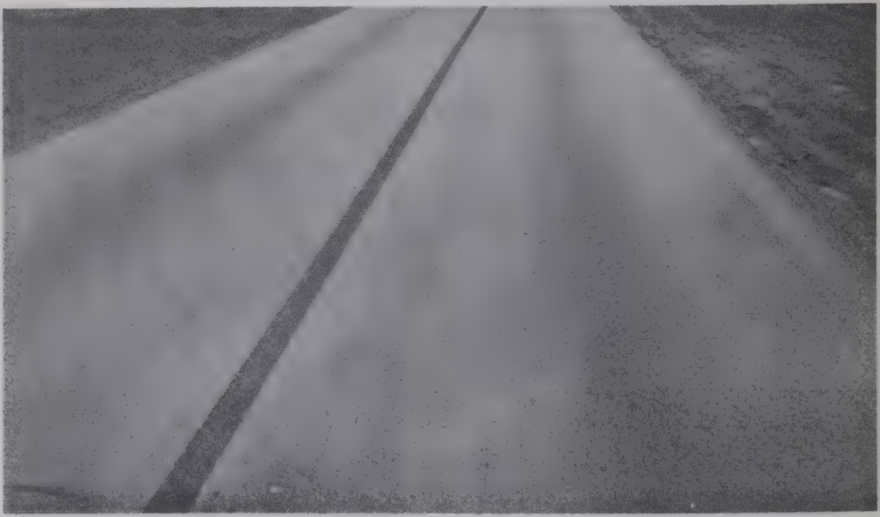


Figure 1

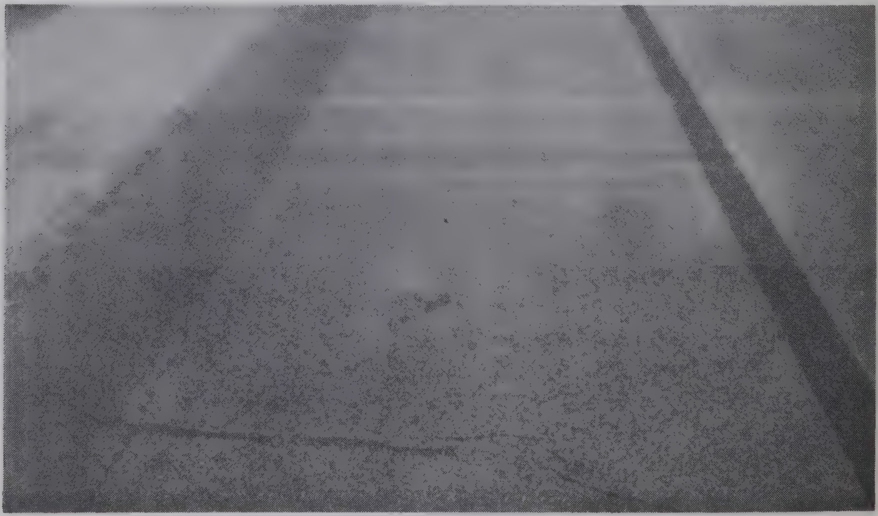
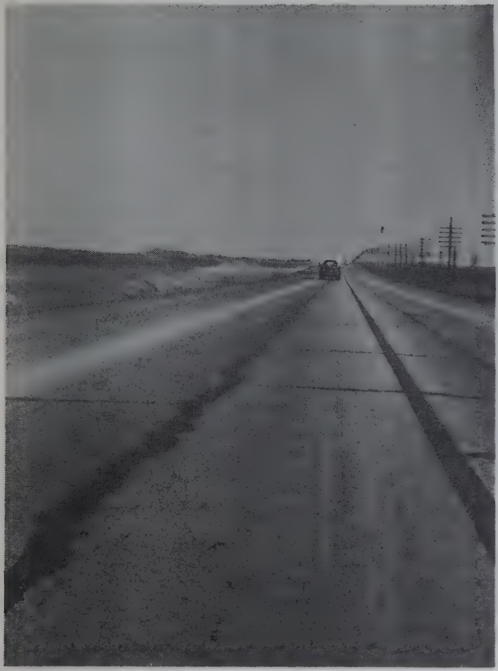
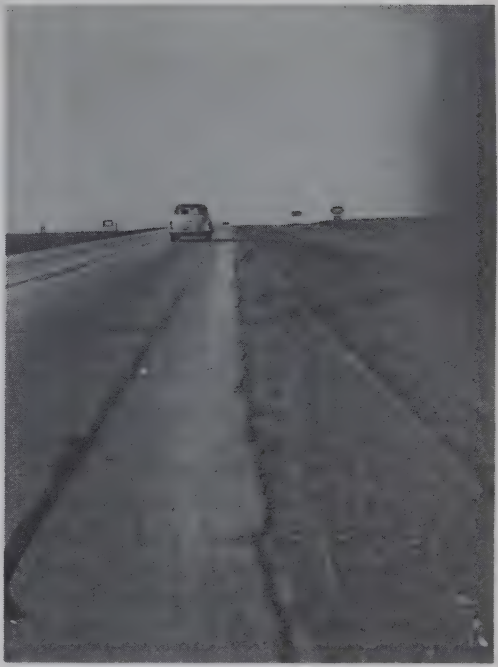


Figure 2 (Portland Cement)

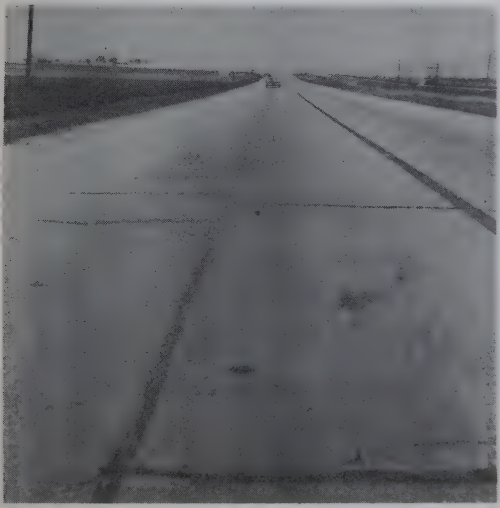
Concrete pavement widened with hot mix asphaltic concrete, 1125 pounds per square yard. Both old concrete and widening surfaced with five inch thick hot mix asphaltic concrete. Figure 1 is wire mesh reinforced. Figure 2 is not reinforced. -Four years old-



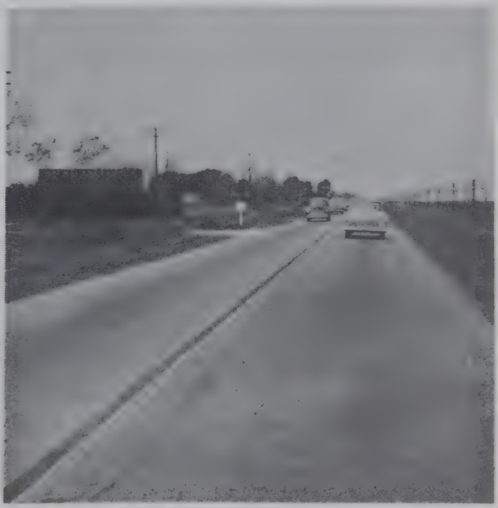
Portland Cement Concrete Pavement widened with Portland Cement Concrete Pavement on one side. Level-up course is less than 2 inches thick. Note position of traffic as contrasted to that on pavement widened on two sides. Twelve years old.



Note traffic path of vehicle where narrow widening strips are placed on both sides.

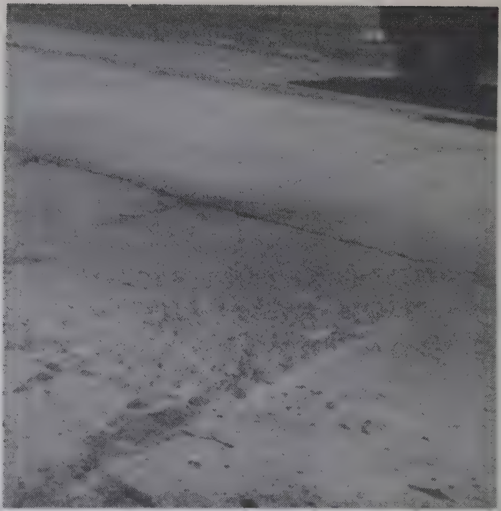


Portland Cement Concrete Pavement widened with Portland Cement Concrete Pavement on one side. Surfaced with 200 pound per square yard hot mix asphaltic concrete. Five years old.



Portland Cement Concrete Pavement widened with Portland Cement Concrete Pavement. Surfaced with 125 pound per square yard hot mix asphaltic concrete. Four years old.

Portland Cement Concrete Pavement resurfaced with 8 inch flexible base plus 3 inch thick by 24 foot wide hot mix asphaltic concrete. Widening constructed of flexible base material and extends to below bottom edge of old pavement. This is less than one year old.



Portland Cement Concrete Pavement in approximately the same condition as that in Figure 5. Picture was made prior to resurfacing. This section is under contract to receive the same treatment.

TWENTY-FIVE AND THIRTY YEAR AWARDS

Front Row: Max Templin, Jose Urias, Perry Wagnon, R. A. Warnock, Mrs. Warnock (not an employee), Mrs. Marvin Kreuz, R. W. Weddell, Damon Whitaker, Tom E. Williams, G. A. Youngs.
Second Row: W. R. Horn, Albert Lee, R.P. McDaniel, Joe Moreno, Dean Munsell, Frank B. Pinget, C.C. Pittman.
Third Row: O. W. Garrett, R. G.Gilbert, John Goad, Max Hanz, Tracy Hayes, W. M. Heath.
Fourth Row: R.A. Bossy, C. D. Chambers, Tom Chamblis, Frank B. Crawford, J. C. Ferguson, Ted Ford, Clyde Fox.
Back Row: W. W. Finley, A. C, Gentry, D. W. Hooper, M. Schultz, Lewis Barington, W. A. Barnard.

LOOKING AHEAD WITH TRAFFIC ENGINEERING *

Address by D. C. GREER, *State Highway Engineer*

Looking ahead with Traffic Engineering we see on the one hand a picture of the ideal highway system which we should like to provide for the highway users of Texas, and we see on the other hand the reality of the highway system we have today with such improvements as we shall be able to provide with available funds.

We like to picture as our goal a highway system which incorporates design features that automatically eliminate the basic causes of accidents and congestion and which compensate for human limitations by making numerous hazardous driving acts impossible. Such highways can be built, and expressways, of which the Central Expressway in Dallas is a typical example, provide the answer.

If there are those of you who have not had the privilege of driving on an expressway, it would be worth your while to do so and observe the design features which eliminate the causes of accidents and congestion and which compensate for human errors. There is the median divider or physical barrier which separates opposing flows of traffic and makes the head-on type of collision, so common to the ordinary two-lane highway, almost a physical impossibility; there is control of access to the through traffic lanes with carefully designed points of entry and exit which eliminates the constant threat of cars entering the path of a motorist from private driveways and numerous cross streets; there are grade separation structures which eliminate cross traffic at grade with its toll of intersection accidents; and finally, there are multiple lanes for each direction of traffic which provide ample roadway capacity, freedom of movement, and opportunities for overtaking and passing slower-moving vehicles. The multiple lanes also eliminate many of the numerous sideswipe accidents typical of two-lane roadways which occur when a motorist trying to overtake and pass a car is forced by opposing traffic to cut back into his own lane before clearing the car he is trying to pass.

The performance record of the design features of expressways just described is clearly reflected in some interesting figures for the Gulf Freeway in Houston which cover the period from the date it was opened, October 1, 1948, to May 31, 1951. The fatality rate for this period was 1.9 per 100 million vehicle miles as compared with a statewide average of 7.3. This was a reduction of 74 per cent which means that travel on the Gulf Freeway was four times as safe as travel on the ordinary street or highway in Texas. Furthermore, travel-time studies made before and after the Gulf Freeway was opened to traffic show that travel time was cut in half by the Freeway. Using a nationally recognized minimum cost of two cents per minute for operation of passenger cars and five cents for trucks, the cost of about eleven million dollars for the section now in operation would be saved by the users in about four years. Very few investments pay a dividend of 25 per cent per year. The present traffic load on this expressway is 69, 500 vehicles per day, with occasional peak daily loads in excess of 72,000, and the maximum capacity has not yet been approached. These figures should be ample proof that highway facilities can be built to carry large volumes of traffic with speed and safety.

Based on the national average figures, even the divided highway, without refinements of grade separations and complete control of access typified by the expressway, has a fatality rate 40 per cent less than the average two-lane rural highway. Aside from its safety record, the four-lane divided highway provides the traffic capacity so sorely needed by two thousand miles of Texas highways at the present time.

The traffic problem then is one that must eventually be reduced to a basis of economics - the dollars and cents value that the people of Texas are willing to pay for highway facilities incorporating design features that make them inherently free from accidents and congestion. In 1950, Texas paid a toll of 96 million dollars in economic loss from traffic accidents in which 2, 100 people were killed and an estimated 68, 000 people were injured. Whether he has an accident or not, every motor vehicle operator in Texas pays his share of this economic loss, and he who doubts this statement has only to look at the insurance receipt he holds against traffic accidents.

It has been estimated that on a national average each motorist pays gasoline taxes amounting to $30 in a one-year period and an annual accident insurance premium of $60, which is twice the amount of the gasoline tax. Would it not be a wiser investment in terms of highway user benefits to reverse these figures and pay twice as much gasoline tax for needed highway improvements that would cut the insurance premiums against traffic accidents in half? Engineering holds the answer for the permanent cure of 50 to 75 per cent of the problem of accidents and congestion, but it is for the people of Texas to decide whether their money shall be spent for adequate highway facilities or losses in accidents and travel time from which they receive no highway user benefits.

Let us turn now from the ideal system of highways we should like to provide and face the reality of our Primary Highway System as it exists today - the trunk lines which connect the state's major cities and important population centers of other states. These highways carry approximately 73 per cent of the state's rural traffic, yet they consist of only 33 per cent of the total mileage on the system. They are the nucleus around which our state's transportation system is built, and yet we had only 29 1/2 million dollars to spend in 1950 for construction and modernization of this system. Some sections of this PrimaryHighway network were built back in the Model "T" days and were entirely adequate for the needs of that time. The multiplied traffic demands of today, however, throw a serious hardship on the road user who is compelled to travel over such antiquated traffic-ways. We have about 2,000 miles of such highways which, according to any standards, should be divided with a minimum of two lanes for each direction of traffic. Yet today Texas has only 600 miles of highways which have been provided with divided traffic lanes. This deficiency alone is taking a tremendous toll in life and damage to property, in addition to extracting the penalty of time and inconvenience from the people who use the heavily-traveled roads.

The bridges on the Texas Primary Highway System are also creating serious bottlenecks in our transportation system. One out of every ten bridges on this Primary network is too weak to carry a load which is well within the legal limits as specified by Texas laws, and they must be restricted to loads less than the legal limit to protect them from further damage. Aside from the weight limitations, approximately half the bridges on the Primary Highway System are inadequate as to width and vertical clearances for the traffic that is now using them. The physical hazard these structures present to the traveling public is well documented in the annals of those who record the violent deaths that occur in our great state.

The age of a highway is perhaps the best gauge of the service it is now able to render. Generally speaking, 20 years is considered the average useful life span of a pavement. In 1940 when our System was still young, there were only 40 miles of pavement on the Primary System that were more than 20 years old. Today, 1, 800 miles have withstood the pounding of two decades, and by any recognized standard, they should be completely rebuilt. At the same time, we are facing the stern fact that more than half of the entire Primary System of today is past the midway mark of its 20-year life expectancy. This is indeed a serious situation. For years, most of these Arterial routes have required widening, reinforcing, and straightening to meet our increased traffic demand. The money just was not in the treasury to do all of this essential work, and at the same time meet the obligations for construction and maintenance commitments on the other branches of the over-all road network.

A recent study of this Arterial network which carries nearly three-fourths of the state's traffic reveals that over one billion dollars would be required to modernize it to standards that provide reasonable safety and convenience to the traveling public. In sharp contrast, the funds available to the Department this year will permit only 29 1/2 million dollars to be allocated for the vast and impelling needs of construction of this basic element of our transportation system. As we look ahead to this year's program, it simply means that we will have to spend a good part of our efforts and the funds that are available in making the best possible use of existing highways. Such a program will include: (1) maintenance, (2) localized structural changes, (3) judicious use of traffic control devices, (4) application of control measures authorized by law, (5) cooperation with municipalities on local traffic problems involving highway routes, and (6) cooperation with state enforcement, education, and safety organizations.

The Maintenance Program is one of the Highway Department's primary recourses in making the best of what we have. Aging pavements, the addition of more than 3, 000 miles of farm to market roads to the Highway System each year, and the constant pounding of increasing volumes of traffic and heavy loads exact their toll and place an increasingly heavy burden on maintenance. Last year the bare upkeep of the Highway System cost nearly as much as was available for construction on the entire Primary Highway System.

A good part of maintenance work will be devoted to surface repairs in an effort to keep the riding qualities high and hold wear and deterioration to a minimum. Other maintenance efforts will be devoted to seal coats for worn and slick surfaces, shoulder improvements for increasing the effective lane width of narrow pavements, removal of sight obstructions to decrease traffic hazards, and mowing of rights of way to keep traffic signs uncovered and present a more pleasing landscape for the motorists.

In spite of the best efforts of our regular Maintenance Program, we sometimes lose the battle with deterioration on some sections of highways and it is necessary to resort to localized structural changes, so-called because they must of necessity be limited to sections of highway or specific locations. Such structural changes, which might also be called capital betterment projects, include pavement and bridge widening, resurfacing of pavement, redesign and channelization of high accident intersections, and shoulder improvements. In selecting improvements of this nature, priority will be given to those sections of highway or locations which carry the heaviest volumes of traffic and which have the worst accident records.

There have been some notable projects involving widening and resurfacing of pavements, widening of bridges, and shoulder improvements within the past few years such as U.S. 77 between Waxahachie and the Hill County Line, U.S. 81 between Itasca and the Johnson County Line, and between Waco and Lorena, U.S. 290 in Harris and Waller Counties, and U.S. 75 between Corsicana and Ennis. The changes in these sections of highway have brought about gratifying results. Not only has their capacity to carry traffic been increased by 30 to 51 per cent, but the safety factors have been greatly improved. It must be remembered, however, that widening and resurfacing of pavements is not cheap, costing 40 to 60 thousand dollars per mile, and that it is designed basically as a measure for protecting the state's investment in the existing highway by prolonging its useful life.

Not only will we be concerned with problems of maintenance and structural improvements on sections of highways, but we are faced with a tremendous problem of traffic operations which will require an extensive program of traffic control devices such as signs, signals, and pavement markings, as well as a program of speed control measures such as speed zoning and marking curves with safe speed indications. These traffic control devices and regulations are absolutely essential for the control of traffic on highways of inadequate design that do not have self-operating and control features built into them.

Consider the STOP sign and ordinary "stop" and "go" signal which serves the function of assigning right of way to traffic, the STOP sign usually to one street, and the signal alternately to one street and then to the other. In one sense of the word they are substitutes, and poor ones, for the ideal design which would be a grade separation providing for continuous movement of cross traffic. The center line on two-lane or four-lane undivided pavements is the most commonly used device for separating opposing flows of high speed traffic, a function which is served by positive barriers and median islands in the ideal design of divided highways. The barrier stripe for no-passing zones, which is designed for restraining impatient and overanxious motorists from overtaking and passing in areas of restricted sight distance, has no counterpart in the ideal type of divided highway design, but it is not necessary where there is a second lane available for overtaking and passing at all times.

Speed control measures, like traffic control devices, must also be used on obsolete highways that were not designed for the speed of modern day cars. The Highway Department will strive to attain a well-rounded and intelligently applied speed control program that will accomplish these objectives: (1) a guide to traffic for those locations or sections of highway which require a reduction of speed for safe operation, (2) increased capacity of roadway through encouraging more motorists to drive in the same speed range, (3) an aid to the enforcement officer, and (4) a reduction of accidents at locations where speed "too fast for conditions" is a contributing factor. This program is predicated on the belief that speed limits which seem reasonable to the motorist will command his respect. Such speed limits can be determined only through factual studies including speed checks, width of and condition of pavement and shoulders, roadside development, frequency of intersections, curves, sight obstructions, and accident records. There have been far too many arbitrary and unreasonably low speed limits invoked under the weight of public pressure, and they were doomed to failure at the time they were enacted.

We feel that the Highway Department can point with a pardonable degree of pride to the progress that has been made in the past few years in marking curves with safe speed indications. You have, no doubt, seen the yellow Warning sign erected under the curve sign and on the same post with it. This sign shows the speed at which the curve can be driven without an uncomfortable sidethrow and still permit the motorist to stay in his own lane. These advisory speeds are posted only after trial runs have been made in a car equipped with an instrument called a ball bank indicator which takes into account the superelevation, coefficient of friction, and sidethrow at different speeds. It is our intent to post the safe speeds on curves at the highest possible value which is reasonably safe so they will command the respect of motorists by meaning what they say.

Perhaps the foregoing explanation of the Highway Department's program of traffic control devices and control measures has explained to some degree why they are necessary. Frankly speaking, we do not like restrictive controls any better than the average motorist, but we have no choice other than to use them until funds are provided to build highways designed for freedom of movement and safety without restrictive controls.

Aside from those functions which are the assigned responsibilities of the Highway Department, we shall cooperate with other governmental agencies who are vitally concerned with the traffic problem. We shall work with municipalities on local traffic problems involving highway routes, and we shall work with the Texas Education Agency, the Department of Public Safety, and the Texas Safety Association on problems of mutual concern.

The traffic problem is indeed a serious one, and as we look ahead with the Engineering phase of the problem, it is my prediction that it will grow worse and worse before it grows better unless funds are made available to provide highways with built-in safety measures adequate to meet the demands of modern day traffic. We know how to build them right, but it will take money. We can build Pennsylvania Turnpikes, but somebody must pay.

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* Address by D.C. Greer given at the Texas Safety Conference in Dallas on March 24, 1952.

Attachments on Dump Trucks . . .

PALMER MASSEY, *District Engineer*

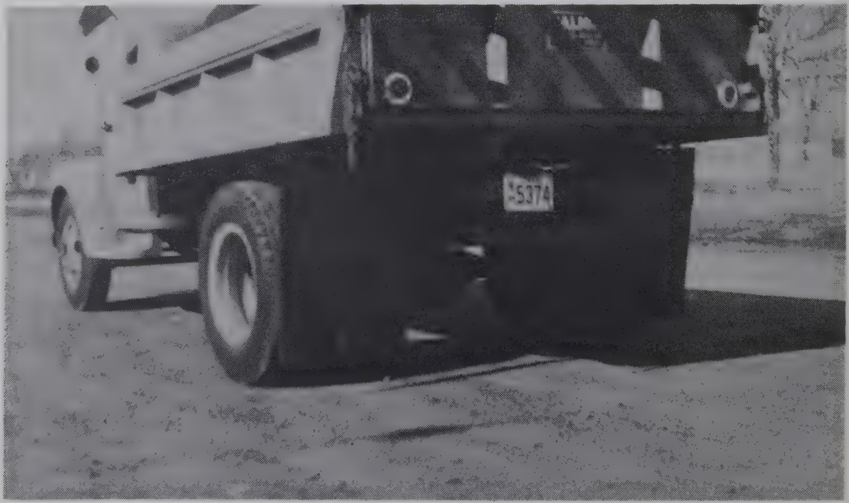
The pictures below show the method used in attaching mud guards to our trucks, and other additions to our dump trucks.

The mud guards are suspended from the second cross member from the rear of the body. When it is desired to have these mud guards raised, the brass grommets at the lower end fasten to a hook under the end of the truck bed.

The photographs also show an auxiliary 45-gallon gas tank set between the cab and the bed with the spare tire mounted on top of it. The openings in the wheel provide for rear view vision. The tire provides protection to the glass and cab while the truck is being loaded. The auxiliary gas tank is especially desirable when the truck is used on long hauls and on snow removal when every minute counts.

The safety prop shown in the pictures was developed from similar arrangements observed on the dump trucks in the Wichita Falls District. It provides additional safety for the men anytime they need to be under the truck bed. This steel prop hinges on the lower end and lies in a horizontal cradle when not in use. When placed in the upright position a bracket it leans against holds it in position until the truck bed comes to rest on it.

All the additions mentioned herein were made here in the District Shop. Mud guards were installed on the trucks prior to receipt of information showing other methods of installation. However, in this windy section of the State we believe our method might be preferred.



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TEXAS
HIGHWAY
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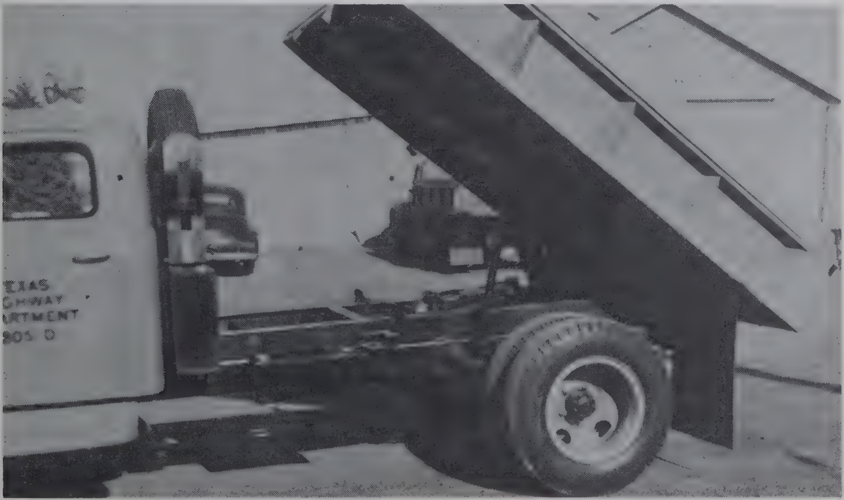
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ABOUT THE DISTRICTS

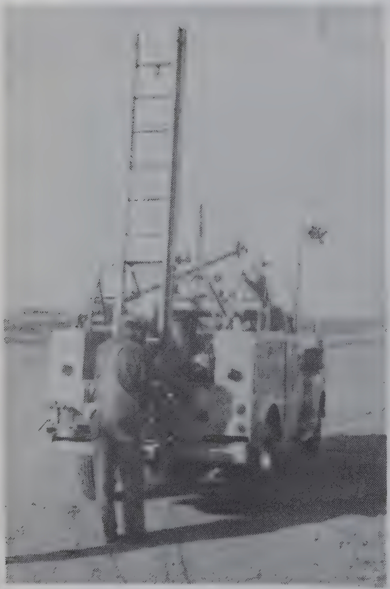
DISTRICT 25'S PICKUP WITH SPECIAL EQUIPMENT

We find the Chevrolet Model 3803 one-ton pickup pictured here very useful for our Field Mechanic because of its versatility. It is equipped with a combination light duty maintenance and general service body with a detachable overhead ladder.

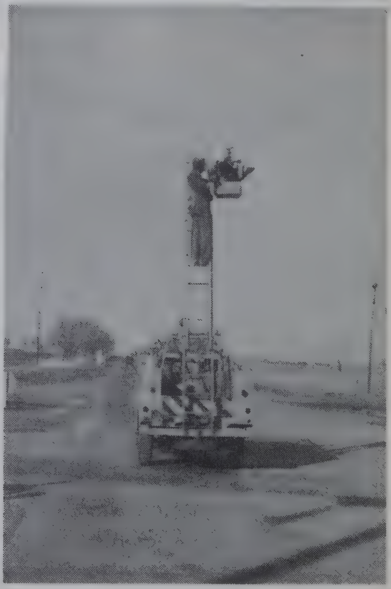
The five-ton winch attachment does not show clearly in these pictures, but it is very vital to the usefulness of this piece of equipment.

The equipment was received new in this District in September, 1951, equipped as shown except for the changes listed below.

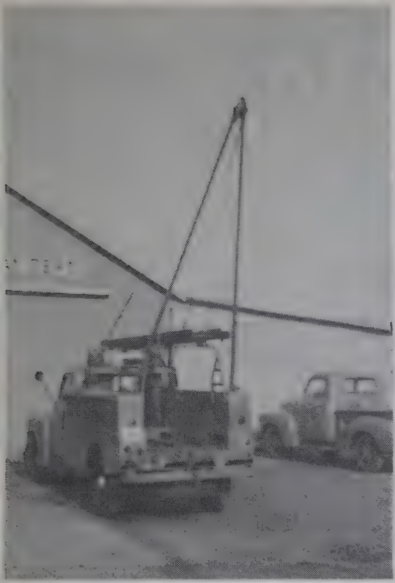
1. The "A" frame support was moved from the top of the bed down into the bed.
2. The vise on the rear end was added.
3. The acetylene and welding drum brackets were added.
4. The "headache bar" for the "A" frame was attached.
5. Additional bins in the storage compartments were installed.



Ladder being raised to repair traffic light.



Ladder raised - L.H. Meinzer, Field Mechanic, repairing traffic light.

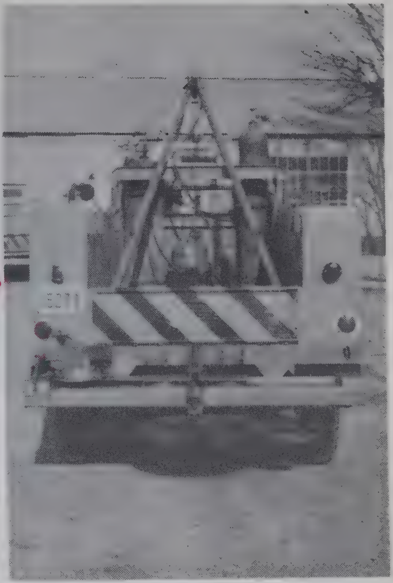


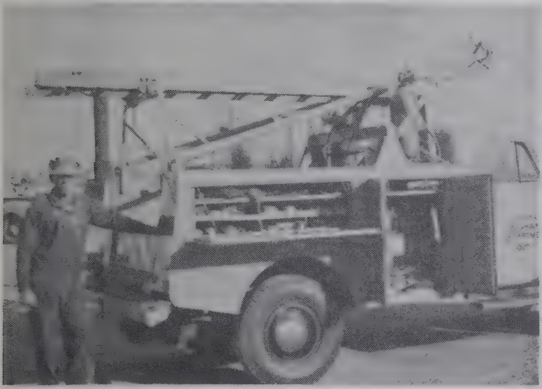
"A" Frame in position for setting poles up to a length of 35 feet or making other high lifts to 18 feet in height.

⇦

⇨

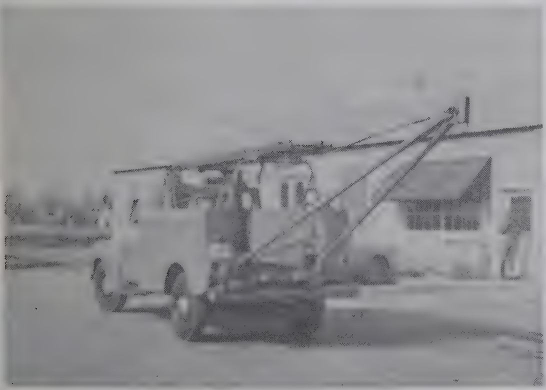
Rear view with welding equipment in place and vise on bumper at left side. The vise is mounted on a beam that will slide back 12 inches and turn to a 90 degree angle by only pulling a pin.



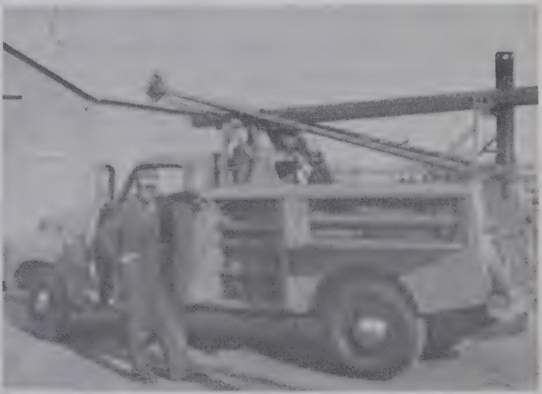


Right side showing tool trays and acetylene cutting equipment storage compartments.

Front view showing 3-gallon thermos can on right fender.

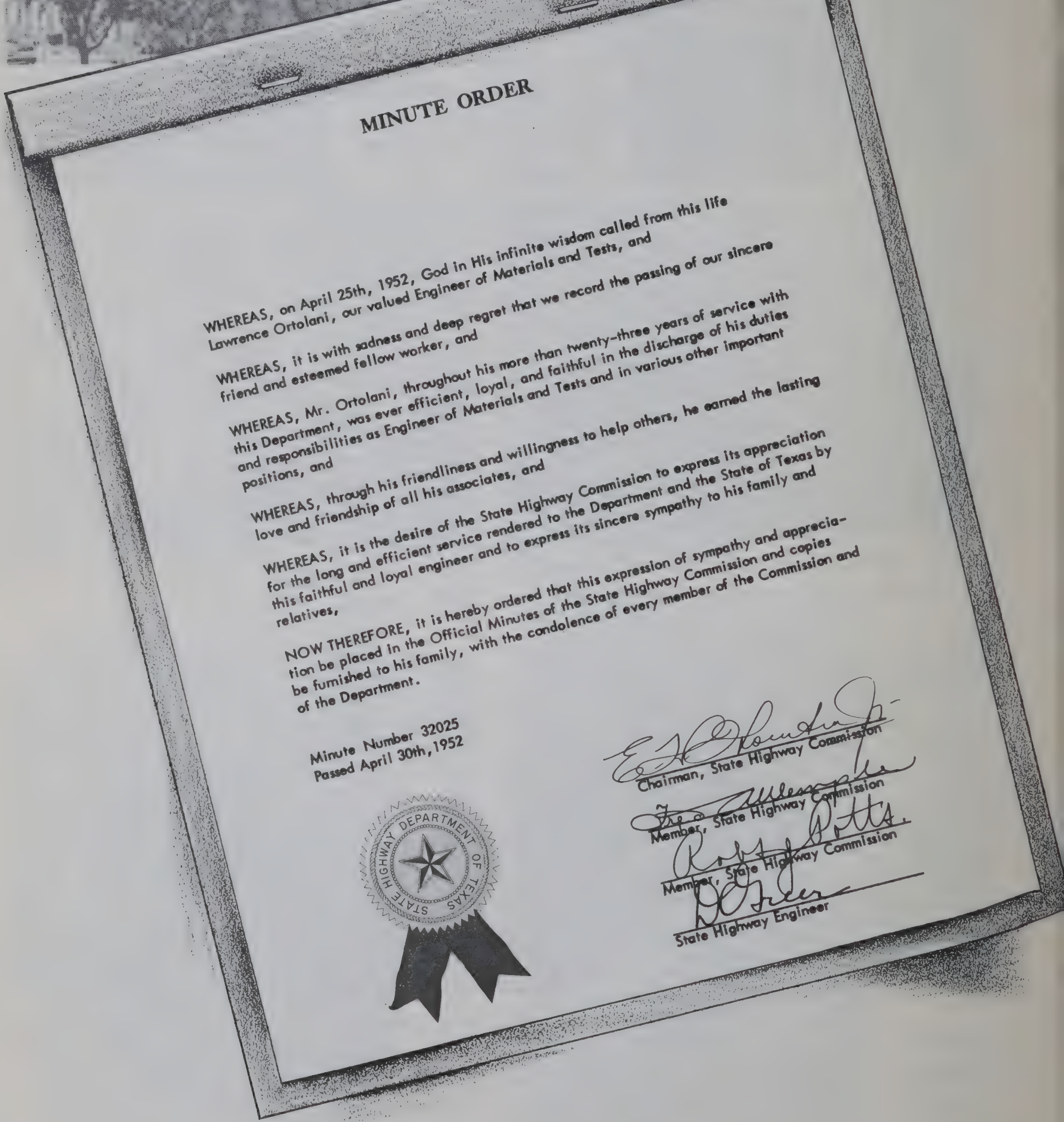


"A" Frame mounted in the bottom of the bed ready for lifting engines, tandem cases, or anything up to 2,500 pounds. By removing ladder rack and ladder and using a chain hoist on the "A" Frame, an engine or other equipment can be set in the bed of this pickup and hauled to the District Shop for overhaul.



Left side showing tool trays and parts storage space with ladder and "A" Frame in place ready to take off to job in the field.

... HALF MAST



MINUTE ORDER

WHEREAS, on April 25th, 1952, God in His infinite wisdom called from this life Lawrence Ortolani, our valued Engineer of Materials and Tests, and

WHEREAS, it is with sadness and deep regret that we record the passing of our sincere friend and esteemed fellow worker, and

WHEREAS, Mr. Ortolani, throughout his more than twenty-three years of service with this Department, was ever efficient, loyal, and faithful in the discharge of his duties and responsibilities as Engineer of Materials and Tests and in various other important positions, and

WHEREAS, through his friendliness and willingness to help others, he earned the lasting love and friendship of all his associates, and

WHEREAS, it is the desire of the State Highway Commission to express its appreciation for the long and efficient service rendered to the Department and the State of Texas by this faithful and loyal engineer and to express its sincere sympathy to his family and relatives,

NOW THEREFORE, it is hereby ordered that this expression of sympathy and appreciation be placed in the Official Minutes of the State Highway Commission and copies be furnished to his family, with the condolence of every member of the Commission and of the Department.

Minute Number 32025
Passed April 30th, 1952

STATE HIGHWAY DEPARTMENT OF TEXAS

E H Thornton Jr
Chairman, State Highway Commission

Fred Wemple
Member, State Highway Commission

Robt J Potts
Member, State Highway Commission

D C Greer
State Highway Engineer

"Comments From the Traveling Public"

OVER THE HIGHWAYS

. . . I have driven through Texas several times lately, and you either have or have under construction, a wonderful highway system. However, your highway markers through your towns and cities are inadequate. Larger and better placed markers could be used.

J. P. Huston
Marshall, Missouri

* * *

. . . We enjoyed our trip down from Shreveport and never drove through a more beautiful country and on better roads! Everything was perfect until we came to highway --- near --- ---. They were oiling the road and I was flagged down and told to drive slowly. This I did with several other cars behind me. Half way through the oil stretch, a state truck came towards us at a very fast pace flashing his lights for us to pull over and let him pass. This we had to do or collide with him. As he passed us at a high speed, he splashed my car from end to end and as my car is a convertible with a light top, you can imagine what it is like and it won't come out. I had my window open as it was very warm and both my wife and myself received a good drenching of hot oil all over our clothes and face. For two people that were so happy before this happened, we sure feel that an injustice has been committed against us, and also irrepairable damages to our car top. I belong to the American Automobile Association and am forwarding my complaint to them too.

I hope this won't happen to many more tourists as it surely leaves a sour taste in our mouths plus the expense of trying to remove the oil from our clothes and car . . .

(Signed)

* * *

. . . Texas is a very fine state and quite apparently wealthy. The finest roads in the country, beautiful farms, and innumerable oil wells make a state of which you may well be proud . . .

E. A. Martin
Sudbury, Ontario
CANADA

. . . We should like very much to reprint in our Virginia Highway Bulletin the article entitled "Who Said, 'Preventive Maintenance'?" -- which appeared in the November issue of Construction and Maintenance.

If you would be so good as to give us permission to use the article -- with proper credit, of course -- we'd consider it an extra favor if you'd let us know right away, since we are most anxious to include this article in the issue we are now preparing.

Floyd H. Mihill
Managing Editor
VIRGINIA HIGHWAY BULLETIN

• • •

. . . I passed my road and kept on driving and never knew I was off the road until I had trouble with my ignition distributor on my Model A car about forty miles from nowhere. I couldn't flag down any trucks or cars, and it was about 2:30 p.m. The traveling public are not very brave or just down right selfish, and all the same as a gangster or criminal. There should be a Texas law, where on a long stretch of highway like that piece of road, where there is no water or any living human being, and the Texas traveling public refuses to stop and carry any message for a lady or gentleman, they should be fined. Texas is a large State, and called the one of the Bravest of men, and for men to disregard a man of sixty four years of age, who wanted to send a message so I could fix my ignition is what I call a no good person and a coward or criminal . . . I am an ex-soldier and can take care of myself if anyone wanted to start something with me. I am a Texas ex-cowboy, when men were men, and would stop and help a man fix his freight wagon or render aid . . .

The Texas Highway Department men stopped and towed me to a tavern, after they got done work. This man who runs the tavern acted like he didn't want me to leave my car there, after we had refreshments there at his place . . . I didn't like that man's hospitality and didn't want to leave my car there . . .

The foreman said O.K. we will take you on into camp. I had plenty of food, as I had been out on the road two months, sharpening cutlery, lawnmowers, saws and so on, but was on my way home . . . So they treated me just like I was in my own home . . . I wish to write in to the State Highway Department and tell them what a fine bunch or crew they were for doing so much for me. . . . I would be glad to sharpen some tools for them . . . Give them some praise for not only helping me but some lady had a flat tire and they stopped and put on her spare tire for her, where some one had abandoned her . . . I write this letter which took place about two weeks ago. I remember it blew up a cold norther that night and caught me without any woolen underwear as I had taken it off . . . I want to congratulate the State of Texas for their fine help to the traveling citizens . . .

Closing very respectfully

(Signed)

. . . This letter is in regard to an accident involving a Texas Highway truck and a car in which my husband, Mr. --- --- was riding with Mr. --- ---. Mr. --- car was a total wreck and he was in the hospital four days. My husband was in the hospital twenty-seven days and had an operation on his right wrist joint which was fractured. They removed his left kneecap. He had three bone specialists and his regular doctor. It was the fault of the highway truck. No effort has been made to settle or to help him with his expenses.

This accident occurred November 5, 1951. My husband is still off work and doesn't know when he will be able to go back.

Mr. --- was born and raised in --- County and the people there and in --- County are really concerned in this accident as lawyers tell us we can't sue the State so what are the poor people going to do? We have to have insurance on the other guy but the State can ruin a man for life and it's O.K.

Will be waiting for a reply . . .

(Signed)

• • •

. . . My wife and I recently had a nice motor vacation through the "Heart of Texas" which we thoroughly enjoyed. I have made comments on the survey card, but what we missed most was butter. You cannot pawn off Oleo on a midwesterner. It's just unfair that one cannot be served butter. I am talking about AAA and Duncan Hines recommended places (Did have it at the Shamrock).

If we wear your cotton you should eat our butter and not consider it a hardship.

Enjoyed the trip and thanks for the courtesies.

E. H. Quandt, M.D.
Rockford, Illinois

P.S. Advised a patient to fly down to Brownsville for his vacation which he will next week.

• • •

Comment from the Denison Information Bureau . . .

. . . We had a truck driver to tell us about hanging his trailer under an underpass with markings indicating plenty of clearance for his height. The highway had been resurfaced making the vertical clearance several inches less. The clearance figures had not been changed.

• • •

IN MEMORIAM

Theodore Hill was instantly killed February 21, 1952, when hit by a car that had gone out of control after slipping to the shoulder. Mr. Hill and others were engaged in patching surface with asphalt on U. S. Highway 81, north of Troy in District 9.